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APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, ANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 3 No. 35 (new series) NOVEMBER, 1957

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metal finishing Journal

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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BROADENING THE BASE

THE massive structure of technical institutions, institutes and societies which has grown up in this country is in many respects a uniquely British concept, having no exact counterparts in other countries. Although there are, in the U.S.A. for example, numbers of eminent technical bodies which appear ostensibly to be conceived on similar lines to their British counterparts and to fulfil the same function, the resemblance is in fact largely superficial. There is, for example, very little attempt to set down any stringent qualifications for membership, and in most cases interest in the widest sense in the subjects catered for by the organization is sufficient to render anyone eligible for membership. Furthermore, American and other technical organizations are much less concerned by the alleged dangers of contamination by contact with commercial interests than are similar bodies in the U.K., which in some cases lean over backwards to avoid any possibility of commercial taint.

While it is manifestly undesirable for an independent technical body to be a sounding board for the propaganda of any particular commercial interest, or that its policy should be in any way dictated by its interets, it is nevertheless incontrovertible that the majority of technical organizations exist to serve the ends of industry through their technical activities and, for this purpose, receive the greater portion of their membership and financial backing from industrial sources.

It is from a liberal minded recognition of this hard fact of existence that the much more broadly based structure of technical bodies outside the U.K. has come into being, and one of the beneficial results of this has been that technical interests have been far less confined into hermetically sealed cells with the minimum of contact with their kindred technologies.

While in certain fields of human endeavour progress and achievement is best fostered by ever narrower specialization, this is by no means universally applicable and a very strong case can be made out for the acquisition by those who have technical responsibility in industry of as much knowledge as can reasonably be gained of all subjects pertinent to their technology.

It is often argued that at the present rate of technical progress on all points, specialization is essential if anyone is to attempt to keep up to date in his particular subject, but while admitting the palpable truth of such a claim it is nevertheless equally true that considerable benefit can be derived from looking as widely as possible.

Although the immediate post-war popularity of visits to various works has abated somewhat in recent years, works visits still form an intrinsic part of the programme of many technical bodies, and sometimes, among the more enlightened organizations, arrangements are made for visits to works carrying out processes entirely divorced from the technical interests of the body concerned. Thus we find steel makers visiting breweries, enamellers visiting steelworks, and brewers visiting paper mills. Such visits are not really in satisfaction of idle curiosity, in which case they would be largely a waste of time, but such is the nature of industrial problems today that many a manufacturer can find the answer to his own particular headache in the methods adopted by some totally unconnected industry. It would appear then that there are two concepts which are worthy of consideration by our technical institutes — whether their ends might not be more effectively served by a liberalization of membership qualification and whether they should not include from time to time in their technical programmes contributions from experts in other technologies.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

TAKING THE MOUNTAIN ...

ONE of the Research Associations is proposing to send teams around the country to carry out "on the spot" research investigations for non-member firms on specific problems to prove to them that research is worth while. This is indeed a commendable thing to do, but the teams may well find that they have bitten off more than they can chew. It is all too easy to assume that small companies, apparently doing no research or taking any interest in their industrial research associations, must inevitably be antiquated and out of touch with modern developments and that a bright graduate could show spectacular results very quickly indeed. This is often far from being the case.

Most small firms are customers of large companies with ample resources upon whose knowledge and experience they can, and do draw. After all, it is commercially advisable for suppliers to ensure the efficient use of materials and processes. In this way the results of research penetrate down to the most unlikely depths, if only at second or third hand, remarkably quickly. It is not unusual to find small firms using advanced electronic equipment, complex chemicals, or specialized alloys with complete success, even if they would be hard put to explain the theoretical background behind them.

There are many ways of benefitting from results of research, not all of them very obvious.

PLACING THE BLAME

IN a recently published paper on corrosion in buildings two distinguished authors describe various failures which have occurred through bad design. In a footnote, however, they rather apologetically make a disclaimer to the effect that the use of the words "faulty", "bad", etc. in connection with design is not intended to cast aspersions on the professional competence of any architects or engineers who may be concerned, but refers to "the corrosion aspect only."

But this surely, is, exactly what the paper does do, unless we are to assume that the corrosion aspects of an architect's or engineer's job are so specialized that he is not expected to know anything about them or to accept responsibility for failures that may occur through corrosion effects which ared irectly ascribable to design. Today a knowledge of corrosion is a most important part of the training of any engineer, and it would not be unreasonable to expect a competent designer to be sufficiently knowledgeable on the subject to avoid the more obvious pitfalls, some of which the authors describe in their paper. After all, if a fine-looking building collapsed because the girders were not strong enough, no one would exonerate the architects because it was from the stress aspect only that the building was unsatisfactory !

ALUMINIUM SPRAYING

THE porosity of sprayed aluminium coatings has always been cited as a criticism of their effectiveness, but recent work at Cambridge indicates that this may actually be a positive advantage.

The reason is that the coatings are apparently more reactive than aluminium in the massive form and in chloride solutions they can give cathodic protection to the underlying steel, rather like zinc. In tap water, on the other hand. where the aluminium is less rapidly attacked, there is little or no cathodic protection, but protection occurs by blockage of the pores in the sprayed coating.

This information will help to clear up the doubt some people have had regarding the effectiveness of aluminium coatings under marine conditions.

FLASH!

I LIKE this advertisement in the "News Chronicle" for a wrist watch: "A wizard timekeeper. Solid leather strap with genuine microns of real gold flashed into the case."

Such vivid prose makes British Standard Specifications very dull reading indeed by comparison. One can almost hear the volts hurling the microns of real gold into the case and see the blue flash as they impinge—and not imitation microns at that, but the genuine thing !

ATOMIC CURE

EVERY so often rubber-lined tanks give trouble with bright nickel solutions, and this is generally ascribed to the presence of sulphur-containing accelerators used during the vulcanizing process. It is therefore nice to know that it is now possible to vulcanize rubber without the use of either heat or accelerators by means of nuclear radiation. The initial tests were carried out on a tyre which was vulcanized by rotating it slowly over radio-active fuel elements. Tests showed that the resulting tyres had considerably better resistance to ageing and deterioration than conventionally vulcanized ones.

While rubber-lined tanks vulcanized in this way are not yet "around the corner" this is the first basic change in the vulcanizing process in over a century and its significance is therefore considerable.

THE DECORATION OF TINPLATE by Roller Coater and Offset Tinprinting Machine

by J. M. BOYLE* and J. MATTHEWS*

(*A Paper presented to the Annual Conference of the Institute of Sheet Metal Engineering, London, October 30 and 31, 1957*).

Introduction

IT is the aim of this paper to give an insight into the development of the art of metal decoration during the past decade and also to give those who are not already familiar with the subject an introduction and explanation which they will find of some use and interest.

Despite improved mechanical aids and equipment, the application of roller coatings and printing inks is a skilled job necessitating experience and a proper appreciation of the need to maintain controlled conditions of film weight, viscosity and stoving temperatures and, in lithography, the correct balance of ink and water.

However, with special reference to the lithographic process for tinplate decoration the skill of men other than the printer must be acknowledged. Before the design reaches the machine, the creative artist, process photographer, retoucher and printing plate maker will each have made their very important contributions.

Likewise at this point the skill of the steel maker and tinplate manufacturing firms within the steel industry must also be acknowledged—without their work and progress over the years many of the modern decorating techniques to be described would not have been possible at all.

This paper is concerned with metal decoration on flat sheets of tinplate or steel which are to be fabricated after the decoration has been completed.

Decoration of that side of the sheet which is to become the internal surface of the container usually takes the form of a gold lacquer. The external decoration covers several functions in that it :—

(*a*) Protects the outer surface from corrosion ;

(*b*) Provides an attractive appearance, thereby giving it sales appeal ;

(*c*) Gives a label which cannot easily be damaged.

Techniques

Two basically different techniques are employed to provide the decoration, these being :—

(i) Roller coating ;

(ii) Printing by lithographic offset process.

The roller coating technique is employed to apply the internal lacquer where required and the base coating so often necessary. Here it must be borne in mind that metal decoration is quite different from paper printing, in that the paper has its inherent colour on which designs may be printed, whereas on metal decoration, the base colour must first be applied over metal before printing can commence. In addition, all metal decoration must be protected by a finishing varnish to avoid marring of the print during fabrication and subsequent handling. This final varnish coat is also applied by the roller coating techniques.

The printing of the design over the base coat is done by the offset lithographic process. For this, a planographic printing plate is used in which the image to be printed is receptive to ink of a "greasy" nature and the non-printing area is receptive to moisture. A separate printing plate is necessary for each colour to be printed and one or two colours may be printed at a time, depending on the equipment available and the design to be printed.

In order to get a clear understanding of what is involved it is perhaps best to outline briefly the basic steps to produce the printing plate which carries the design to be printed on the sheet of tinplate and perhaps can be rightly described as the heart of the machine.

Every design has its beginnings as an original, which may be, for example, an artist's painting, a colour photograph, colour transparency, or simply a black and white composite sketch. From this original, the art of photo-lithography is applied for the purpose of producing images on the surface of zinc, aluminium or steel printing plates.

The original, after being squared up and having register marks added, is placed in front of the process camera, illuminated by arc lamps or cold cathode tubes, according to type of original, and photographed through a series of filters placed in the camera lens. A red filter produces the blue printing negative, green filter the red filter negative,

* The Metal Box Co. Ltd.

blue filter the yellow printing negative and yellow (orthochromatic) filter the black printing negative. Any other colours required in the job can be obtained by a combination of the two most suitable filters.

Photography in this way gives a series of continuous tone negatives, *i.e.*, similar to those produced in an ordinary photographic camera but each representing a particular colour. However, for the purpose of offset lithography the image has to be broken up into a dot formation and to achieve this end a half-tone screen is fitted to the camera. The half-tone dot formation can be seen with a magnifying glass in the pictures in any daily paper ; although not produced by lithography, they illustrate the use of a screen to achieve a graduation of tone, *i.e.*, white to dense black.

Half-tone screens are usually circular and mounted in a carrier marked in degrees. For offset lithography, screens carry either 133 or 150 lines to the inch, but both finer and coarser screens have their uses with different printing processes.

In order to avoid a moire or pattern effect in the ultimate print, the screen angle is changed for the negative of each colour in the job. For example, the blue could be 15, black 45, yellow 90 and red 75 deg.

The main colour correction is achieved by " masking " while making the continuous tone separation negatives ; further manual colour correction on half-tone negatives or positives is carried out locally by a process known as dot-etching. This reduces the size of the dots without affecting their opacity, which is a necessary step when producing the high-quality plates required for good printing.

Printing plates are made from sheets of aluminium, zinc or stainless steel, usually 0.012 to 0.025 in. thick. Overall measurements depend on the size called for by the design of the printing machine. Today, most plates are made by the so-called deep etch method, but during the last few years the bimetallic printing plate, *i.e.*, copper on stainless steel, has found increased usage and is held in high esteem by many lithographers. This plate does not require graining as the stainless steel is naturally receptive to water while the copper image is naturally receptive to ink.

The plate maker is concerned with two essentials :—

(i) To create the design area so that it is receptive to ink and not water ;

(ii) To prepare the non-image areas of the plate so that they will be receptive to water but will refuse to pick-up ink.

Preparations of the printing plate is generally agreed to be one of the most critical factors in lithographic printing. The degree of skill employed, the care exercised in the process and the subsequent handling will all decide the clearness and sharpness of the resulting prints and the useful service life.

With zinc, aluminium and ordinary stainless-steel plates, the first step is the graining operation. This breaks the plate surface into a series of microscopic hills and valleys and so permits the water used in the printing process to spread evenly over the surface instead of forming into separate globules which occur when water is dropped on smooth metal.

The plate is placed in the graining machine which oscillates with a lateral movement. Steel, glass or earthenware marbles are placed on the plate and roll and move over the plate surface as the machine operates. Graining abrasive and water sprayed over the plate and marbles in measured amounts and the movement over a controlled period, causes the abrasive particles to dig into the plate surface and so form a grain. After washing with water and a weak solution of acetic acid the plate is ready for processing through the operations necessary to put the design on its surface.

The plate is next placed on the rotating table of the plate whirler and when spinning at a predetermined speed has a water rinse followed by a light-sensitive coating composed of gum acacia and ammonium bichromate poured on its surface. This is spread evenly over the entire surface of the plate by the centrifugal force exerted by the plate rotation and the moisture remaining on the plate from the water rinse.

By the application of heat from the whirler's built-in heating unit, the drying of the coating is speeded up and when completed it is ready for placing in the printing-down machine to receive the image.

The printing-down machine is a finely engineered piece of equipment capable of extreme accuracy in all movements.

After the printing plate has been clamped to the bed of the printing-down machine and the glass negative or positive (depending on the type of plate being made) has been fixed into the glass holder, they need not be touched again until the printing-down process is finished.

The plate is moved in the required steps from end to end and the negative and light source (arc lamp) across the width. Contact between the glass and printing plate is made by gentle pressure which is adjustable and automatically controlled.

The length of exposure is controlled by an instrument which integrates the light intensity with the time factor so that a uniform value is applied to the plate each time. This is far more accurate than a purely time exposure which takes no account of voltage fluctuations, carbon faults and so on.

The design on the glass acts as a stencil or mask and thus is reproduced on the light-sensitive coating

on the printing plate. After completion of this process the printing plate is removed from the printing-down machine and is inked up, developed, corrected and etched, according to the method being used to produce an ink-receptive design and a water-receptive non-printing area.

It must be appreciated that after each operation is carried out in metal decoration, whether it be the application of roller coatings or printing inks, the decorated sheet must be stoved in a conveyor oven to dry them completely before the next operation can be carried out.

Here again, it is basically different from paper printing, where drying is effected partly by absorption into the paper and in part by oxidation.

It will be apparent that an elaborately designed tray or container may require as many as ten decorating and baking operations. On the other hand, very pleasing designs can be printed in four colours on a base colour and this often necessitates only two passes through a two-colour printing machine, linked with a tandem varnish unit.

Control of Materials

For the several different types of materials there are common controls used in the application process, *viz.* :—

(i) Film weight ;
(ii) Viscosity ;
(iii) Stoving time and temperature.

Dealing with these in order :—

Film Weight

The accurate control of film weight within accepted tolerance is of prime importance.

Film weight is the measure of the amount of lacquer, coating or varnish on a sheet of tinplate. If the film weight is too high the material may flake or peel during subsequent fabrication of the sheet or, even if this aspect is satisfactory, the metal decorator is wasting money if he applies more material than is adequate for the job he is doing.

On the other hand, if the film weight is too low, then insufficient protection may be given to the plate to prevent corrosion by the product being packed or, in the case of pigmented roller coatings or gloss finishing varnishes, it may give an inferior appearance to the fabricated container and still cost the metal decorator money because of customer complaints.

When a new material is introduced, many application tests on varying film weights, in addition to appropriate packing tests, determine the most economical and satisfactory application conditions.

Viscosity.

In obtaining a standardized and consistent result the control of viscosity is also important. Viscosity is the measure of the fluidity of a liquid. For the purpose of making this check the No. 4 Ford Viscosity Cup is normally used.

There is an ideal application viscosity range for each roller-coating material. One that is too thick could cause application difficulties, such as in getting low enough film weight or poor flow, *i.e.*, instead of lying perfectly flat and even on the sheet of tinplate the film has a broken uneven appearance. On the other hand, if the material is too thin, there is difficulty in achieving the required film weight and when running work requiring stencil, *i.e.*, with some parts of the sheet of tinplate left plain for soldering purposes there is real danger of flooding of stencil occurring with consequent spoilage of work.

Stoving Time and Temperature

The importance of all materials being stoved for the correct length of time and at specified temperature cannot be over emphasized. If a material is understoved it may be affected by the product, be tacky, have excessive odour and/or fail to tool satisfactorily. On the other hand, should a material be overstoved it may become discoloured, fracture during fabrication and all round be totally unsuitable for the purpose intended. Normally, stoving temperatures have a tolerance of $\pm$ 5° F, and the wise metal decorator pays strict attention to his oven controls and temperature-recording equipment to ensure that they are kept in good condition.

The running speed of the line governs the length of time that the coated or printed sheets remain in the oven. Today, all modern lines are equipped with variable-speed drives, with the advantage that maximum speeds can be run to suit the baking characteristics of the material involved.

Materials

The following is a description of the various materials used in the decoration of tinplate. With the exception of printing ink, all are applied by the roller coater.

Sizing or Priming Varnish

The application of a size to the tinplate is normally the first operation. There are exceptions such as when the can calls for an inside gold lacquer, but it is outside the scope of this paper to give these conditions in detail. The use of size ensures that subsequent decoration of pigmented roller coating, and/or printing ink and finishing varnish will have good adhesion to the tinplate when subjected to extreme fabricating stresses.

As a general guide, it can quite safely be stated that unless tinplate which has to withstand severe tooling has been sized, no guarantee can be given that the result will be satisfactory.

The most important characteristics of the size are adhesion and flexibility, but it should be pale in colour in order not to have effect upon the colour

of further decoration. Gloss is of no importance. A properly stoved sizing coat should feel hard to touch, should show no apparent tackiness and should retain its elasticity. Under these conditions, a sized sheet of tinplate will stand up to severe tooling operations and give subsequent decoration on the sheet increased resistance to scratching or marring and improved appearance.

High-Temperature Gold Stoving Lacquers

There are three main reasons for using this type of material on general-line tinplate containers.

(1) For decorative purposes ;

(2) To prevent atmospheric corrosion of the tinplate ;

(3) As a protective coating to prevent chemical action between the product and the tinplate.

For the open-top food cans, the lacquer on the inside acts as a protective coating to prevent interaction between the tinplate and the product, and thus the contents remain clear, fresh and uncontaminated.

Lacquers used for this purpose are chosen very carefully, and only after prolonged packing tests successfully completed is any lacquer accepted for production use.

For example, a phenolic-resin-type lacquer can be used for the inside of meat cans and the bodies of vegetable cans, while for cans to hold coloured fruits an acid-resisting oleoresinous lacquer is used. A third type is an oleoresinous lacquer pigmented with zinc oxide which is used for vegetable and certain meat-can ends.

Pigmented Roller Coatings

This range of materials is used almost solely for decorative purposes and to the layman has the appearance of ordinary house decorators' paint.

They can be supplied in a variety of colours, but to make the best use of these materials the metal decorator usually selects and works to a standard colour range of intermixable shades including white.

The ideal pigmented roller coating must have good opacity at a low film weight, excellent flow characteristics, must dry without tack and be able to accept subsequent prints and restovings without unduly changing colour.

Printing Inks

Taking materials in a logical sequence of application, printing inks should next be dealt with, because having lacquered, sized and coated the sheets of tinplate, they are now ready for the printing operation. Note, however, that all designs on cans do not require the tinplate to go through these operations and a great many call for printing and varnishing only.

A printing ink is essentially an intimate mixture of oils, varnishes, pigments and/or dyes. During the last ten years the ink chemist has developed inks which are far superior to those in use previously. With the use of synthetic varnishes the offset tin printer today has inks which work well on the machine, dry hard and tack-free in the stoving oven in much shorter time than was thought possible only a few years ago. Indeed, the industry owes much of its increased productivity to these new types of inks which have enabled faster running speeds of presses, mechanical handling and flat stacking of the printed sheet of tinplate to become a practical proposition. Previously, all tinplate sheets had to be stripped from the oven wickets by hand, stacked pyramid fashion on special boards to prevent sheets sticking together, and then restacked by hand again on to a flat stillage before passing through the machine to receive subsequent prints or finishing varnish. It is now possible to eliminate these laborious and somewhat tedious hand operations.

Apart from the general-purpose range, inks have been developed to meet special conditions. Advertising tablets are a good example where the very special quality of non-fading is called for. It will be appreciated that it is useless for the tin printer to produce a fine looking tablet which after standing in a shop window or being exposed to the outside elements completely fades in a short time and, therefore, fails in its function of conveying the advertiser's message to the public.

On the printed processed open-top food can, the inks must withstand quite severe processing conditions without discolouration or tendency to bleed or run. Meat packs, for example, are processed in water for as long as 120 min. at 240° F.

Printing-ink development, as indeed with all materials in this industry, is a continuous process, and as research in this field grows the tin printer can look forward to having still better inks which are easier to handle, possess good fabricating qualities and, in short, give him a better all-round quality job.

Finishing Varnishes

The application of the finishing varnish by roller coater is the last step in the production of the decorated sheet. Its function is to protect inks and base coatings from fabricating damage and provide a pleasing appearance to the container or product. Here again, with the introduction of synthetic resins, the varnishes in use today bear little resemblance in quality and performance to those generally available ten years ago.

The ideal varnish must possess good gloss over printing ink, *i.e.*, it must not be absorbed, have good flow as in the case of pigmented roller coatings mentioned earlier, have good colour retention, that is, must not yellow on stoving, be hard and mar-proof and, finally, have good fabricating properties. In addition, special-purpose varnishes are sometimes required. To quote just

two examples, on food cans varnishes must withstand processing at high temperature, and for waiter trays varnishes must be alcohol resistant, otherwise the life of the tray would be short and uneconomic.

There is also today the growing practice of obtaining economy by applying the varnish over the wet printing ink. This again calls for special consideration in formulation. The solvent in the varnish must not destroy the ink film and cause bleaching or running of the colours. Indeed, the gloss and flow should be equal to that obtained over the dry inks. Today, such varnishes have been developed and are finding wide application in the interests of cost reduction (one stoving pass eliminated) and greater productivity from equipment (one sheet pass through the line giving two sheet coats).

Above, gloss was mentioned as a property of the varnish film. For the majority of work this is true but some designs call for special matt finishes which can vary from an extremely fine " egg shell " matt, which term is self-explanatory, to a quite coarse rough finish. These are achieved by the addition of a matting agent either by the printer or his supplier.

Equipment

The modern roller coating line consists of a series of individual units installed in line and linked together by a mechanical drive as follows :—

(i) Automatic tinplate feeder and run-in ;
(ii) Roller coater ;
(iii) Conveyor oven ;
(iv) Automatic oven unloader.

The printing line is built up with similar units with the exception that the printing machine takes the place of the roller coater. In some instances the roller coater is positioned behind the printing machine for the purpose of simultaneously varnishing the final print as mentioned above.

In this context the roller coater is referred to as a tandem coater. Therefore, we have :—

(i) Automatic tinplate feeder and run-in ;
(ii) Printing machine (single or two colour unit) ;
(iii) Tandem coater (optional equipment) ;
(iv) Conveyor oven ;
(v) Automatic oven unloader.

The function and principle of operation of these various pieces of equipment will now be described.

The Automatic Tinplate Feeder and Run-in

The automatic tinplate feeder is equipped with a roller conveyor system in order that loads or stillages of tinplate can be easily and conveniently positioned on the machine. The length of the conveyor and, therefore, the number of tinplate loads which it will accommodate is determined by the space available, but sufficient length is provided in order to make economical use of the fork lift truck which transports the stillages.

Loads of tinplate are normally delivered from the mills in ten, eight or six box lots on a special wooden stillage board which makes mechanical handling a straightforward and simple procedure.

The tinplate feeder automatically raises and feeds the top sheet of tinplate from the load previously placed on the feeder elevator from the roller conveyor, described above, to either the roller coater or the printing machine.

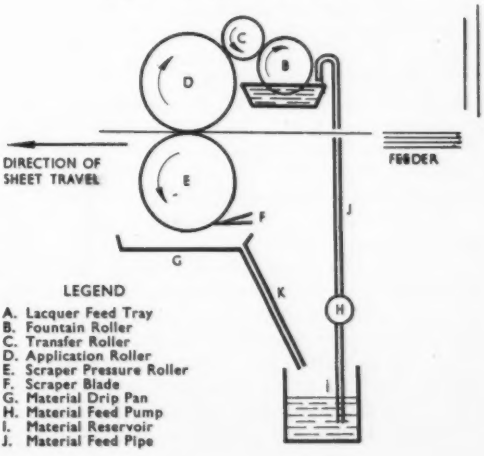
The tinplate stacks are raised by the feed elevator in such a way that the top sheet of the pile is always at the same level. Thus, when feeding, the elevator is inched slowly upwards until the last sheet has been fed. This movement is controlled by a pile height governor and ensures that the top sheet is always within the stroke of the suction separators and forwarding arms.

Separation of the sheets is accomplished by the combined use of magnets and suction separators. Good separation is a " must" for continuous feeding and helps to ensure that sheets will not become jammed in the mechanism. After separation, each sheet is lifted by a pair of front forwarding suckers which pass it to the feed wheels and drop rollers which in turn pass the sheet to the feed table of the roller coater or printing machine.

If, by chance, two sheets should be lifted from the pile and fed to the forwarding mechanism a " two-sheet detector " would automatically divert them to the reject tray. The operation of the feeder is continuous, that is to say, it is not necessary to stop the line when bringing in a new load of tinplate.

It will, of course, be appreciated that delivery of sheets to the printing machine or roller coater must be in time with the sheet register mechanism of these units, and they likewise must be in time with the oven conveyor wickets and sheet unloader.

Fig. 1.—Diagram of roller coater



The Roller Coater

Fig. 1 illustrates diagrammatically the roller coater in its simplest form.

Basically, it consists of a series of rollers, the ends of which are securely held in bearings in rigid side frames.

The roller coating material, *i.e.*, size, lacquer, pigmented roller coating or varnish, is supplied to the feed tray by a pump arrangement from a material reservoir usually of about 5-gallons capacity and sited at floor level. A simple method of supply, to a slow-running line, is by gravity feed from an overhead reservoir but this method is now very much outdated, owing to lack of control and the fairly laborious task of replenishment.

The fountain or feed roller is marked " B " and its direction of rotation is marked. Material picked up by this roller is transferred to roller " C " which is, in fact, known as the transfer roller.

In the beginning, mention was made of film weight control. As the accuracy of film weight control on any roller coater depends entirely on the condition of these two rollers, they must be ground to a perfect finish and run concentrically in their individual end bearings. The amount, *i.e.*, film weight, of material applied can then be accurately controlled by the gap between the fountain and transfer roller. Arrangements are made on the coater for micrometer adjustment between these rollers.

It is usual for the fountain roller to be moved quite independently of the transfer roller, thus the film weight can be controlled and the relationship between the transfer roller and application roller is not affected.

However, again by mechanical design the rollers " B " and " C " can be moved as a unit away from or towards the application roller. This again means that the film weight setting can remain constant but the pressure between " C " and " D " can be easily adjusted and maintained.

On the majority of coaters the application roller consists of a steel cylinder covered with either a suitable rubber compound or a glue-glycerine composition. Some machines are running which have a blanket cylinder fitted in place of the application roller, and in these designs the cylinder is suitably dressed with either a rubber blanket or a glue-glycerine blanket with fabric backing.

Whether rubber or glue-glycerine composition is used for the application of the roller-coating material to the individual sheets of tinplate, they must each be able to resist the solvents used in the various materials and so avoid troubles caused by swelling and distortion of stencils.

The sheets of tinplate are passed between the application roller " D " and the pressure of scraper roller " E," and thus receive a coating of the material being run. The amount, applied, of course, depends on the gap setting between the fountain and transfer rollers which, in practice, is around 0.002 to 0.003 in. for most materials.

Roller " E " is made from chilled cast iron and is ground to a fine true finish.

At point " F " a material scrapper is fitted and this usually consists of a thin blue-steel blade which runs the width of the machine. Pressure between this blade and the roller is adjustable.

Its function is to remove surplus material which collects on the pressure roller and keep it perfectly free from contamination.

The surplus material falls into a drip pan and is then recirculated.

It is essential for the scraper to be kept always in good condition, otherwise trouble can be caused by the backs of the sheets becoming contaminated with the material being run, and in the case of coloured pigmented roller coatings this condition can become severe and lead to spoiled work if the scraper becomes worn out of adjustment.

Roller coaters, like all units in the metal decorating line, are built to take various maximum sizes of tinplate, depending on individual requirements.

Having outlined the basic design of the roller coater consideration can now be given to its handling of the tinplate sheet received from the feeder. In the ordinary or plain roller coater there is little or no sheet register mechanism, the sheets being conveyed through the coater on tapes with perhaps just side guides to keep sheets reasonably square, and that is all that is involved. Therefore, it follows that this type of coater can be used only for overall coating of the sheets.

However, very many classes of tinplate containers require plain margins to be left for the purpose of soldering either side or end seams. In these cases certain clearly defined and accurately measured areas of the tinplate must be left completely free of any decorative materials. Therefore, each and every sheet of a particular job or layout must receive coating in exactly the same position, and this is achieved by a sheet register mechanism combined with stencils cut in the application roller to correspond to those areas of the sheet which must be left clean.

As the sheets of tinplate leave the feeder they are passed to the coater feed table and dogs or lugs on a chain conveyor carry them forward to the point of registration. At this point the conveyor lugs leave the sheet and it is simultaneously taken over by a precision reciprocating pusher mechanism which works in conjunction with a side register mechanism (and sometimes magnets fitted to the feed table, to help give better sheet control).

It should be noted that the pushers correspond exactly to the position of the gripper used in the printing machine and that the side lays also correspond exactly to those of the printing machine

inasmuch that they contact the sheet in precisely the same place. Thus it is possible to ensure complete accuracy of register between the " Spot " roller coater and printing machine.

The Conveyor Oven

On the delivery tapes of either the roller coater or printing machine, the sheets of tinplate travel into the conveyor oven in order that the decorative material applied may receive its correct stoving cycle.

Ovens used in the tin-printing industry can be considered to have four major functions :—

(i) To raise the temperature of roller-coated or printed sheets of tinplate to the specified baking temperature in the shortest practicable time ;

(ii) To maintain the sheets at the specified baking temperature for a given baking time ;

(iii) To cool the sheets to a temperature low enough to permit handling, automatic stacking and rerunning of the sheets without difficulty being caused by tack ;

(iv) To exhaust the volatiles driven off from the decorative materials applied to the sheets.

All conveyor-type ovens are similar inasmuch as individual tinplate sheets are carried by a chain conveyor through a tunnel formed by insulated metal panels which enclose the baking section. Wickets or sheet supports are permanently attached to the conveyor chains and hold the sheets in an upright position as they travel through the baking and cooling sections. The conveyor chains are continuous and travel round sprockets at the front and rear of the oven. In the oven itself the chains are supported on tracks which must be in absolute true alignment. The pitch of a conveyor is really the chordal pitch of the sprocket which drives the chain, but use of the term pitch in this connection indicates the spacing of the wickets attached to the chain.

In this country, the usual method of heating is by gas, while abroad, oil firing is common. The hot air which is used in the oven for bringing sheets to the required temperature is usually heated in an external combustion chamber. Each oven is divided into two zones.

The first is the " come-up " zone, and compared with the overall length of the heating chamber is comparatively short. It is here that the sheets are brought from room temperature up to the required baking temperature by subjecting them to high velocity heated air. The second zone then becomes the maintaining zone and its purpose is as indicated—merely to keep sheets up to the preset temperature for the required time. Depending on the oven length, one or two combustion chambers will be required to feed hot air to the maintaining zone.

Some oven designs are, however, direct internally fired and in this case a series of gas burners runs the whole length of the oven with fans distributing the heated air around the sheets.

The baking temperature range of an oven depends to some extent on its design requirements, but 230 to 400° F. is a common specification for an oven in a roller coating line, while an oven confined solely to print and varnish work would not usually be required to operate above 300° F.

The length of the oven baking chamber can be built to suit individual requirements for speed and space available, with the qualification of conveyor pitch. In this country the normal pitch used is either 1 or $\frac{3}{4}$ in., while in the U.S.A. use of $1\frac{1}{2}$-in. pitch conveyors is common.

From the oven wicket the baked and cooled sheets are either hand stripped and stacked ready for the next pass or, as is now the case on all modern high-speed equipment, the sheets are handled by the automatic oven unloader.

The Automatic Oven Unloader

The advent of higher line speeds and the increase in sheet sizes in common use has meant the virtual elimination of stripping sheets from the oven by hand. Today, there are various types of unloaders in use. These consist basically of two or three units:

(i) The sheet extract unit. This pulls the sheet away from the oven wicket and timing is such that the sheet is well clear by the time the succeeding sheet reaches the extract station.

In its simplest form sheet extraction is by narrow conveyor belts sometimes assisted by rotary magnets, running at a suitable set speed. It will be realized that during this operation the decorated size of the sheet will be face down. In some circumstances this is as required, but if subsequent operations are called for provision must be made for turning the sheet over.

(ii) Again, in the simple unloader, if sheet turning is required, the sheets are fed into an inverter wheel which is simply a series of spokes, fixed in a rotating hub, with, of course, the speed of rotation timed to the sheet extraction.

(iii) Either from the inverter wheel or from the extract station the sheets are fed into a stacker unit which is really similar to the sheet metal feeder running in reverse, *i.e.*, instead of feeding a load of tinplate, it receives and gradually inches the pile down until the load consists of the required number of sheets. The completed load is then run out on a roller conveyor system in exactly the reverse manner to that described at the feed end of the line.

Obviously increased space is required if provision is made for the inverter wheel. One alternative is in the use of a load or bundle turner. With this equipment a load of tinplate can be turned in a matter of seconds.

A wooden stillage board is placed on the load to be turned. The fork-lift truck places the load in the turner, pressure is applied to prevent the sheets slipping and the whole load is turned by a rotary movement. Pressure is then released and the turned load removed by fork-lift truck.

The Printing Machine

All equipment has now been described with the exception of the printing machine. As stated previously the fundamental principle of lithography is that grease and water will not mix together, or stated another way, the process depends upon having ink-receptive and ink-repellent areas on the printing plate.

Fig. 2 shows the basic layout of inking rollers and cylinders on the offset tin-printing machine. Its function is to decorate sheets of tinplate with an inked image of the design carried on the printing plate, which has been fixed to the printing machine plate cylinder.

The sheets of tinplate fed to the machine (from the automatic sheet feeder) do not receive the inked image through direct contact with the printing plate, but through the medium of a rubber blanket which first contacts the printing plate, receives the inked image, and is then transferred to the tinplate while it is being fed between the blanket and impression cylinders. This is known as the " Offset " principle.

The printing ink (the grease in our definition of lithography) is placed in the ink duct, and from here it is carried to the rollers and printing plate. The amount is very carefully controlled and regulated by a series of keys positioned against the duct plate which forms part of the ink fountain.

With all the rollers inked up and the four rubber forme rollers in contact with the printing plate, the image receives its charge of ink. However, also in contact with the plate are the damping rollers carrying a very fine film of moisture to the printing plate to ensure that the non-image areas do not receive or become receptive to ink. If this happens the unwanted ink would print on the sheets and the work would be spoiled.

The printer has a very fine control over both the amount of ink and water which is supplied to the printing plate. As a general guide he always uses a minimum amount of water and a minimum amount of ink to achieve the ideal results. It is his skill which maintains the ink and water in perfect balance throughout a run. If insufficient water and too much ink is padded to the printing plate the work will become thick and half-tones and fine lettering filled in. On the other extreme, if too much water is applied the resulting colour printed will be lacking in strength and appear " washed out." Further, too much water can result in the inking rollers being stripped almost entirely of ink and if the condition is not recognized in time, the only course to take is to have a completely fresh start.

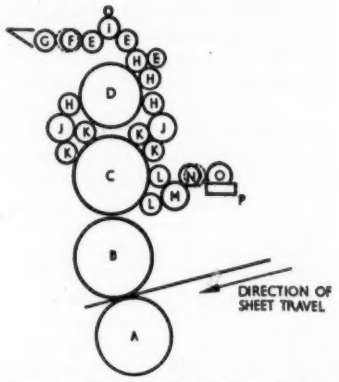


Fig. 2.—Layout of inking rollers and cylinders for offset tin-printing machine

LEGEND

A. Impression Cylinder	I. Steel Intermediate Roller
B. Blanket Cylinder	J. Steel Ink Distributing Rollers
C. Printing Plate Cylinder	K. Rubber Forme Rollers
D. Ink Drum	L. Cloth-covered Plate damping Rollers
E. Steel Ink Distributing Rollers	M. Water Distributing Roller
F. Ink Feed Roller	N. Water Feed Roller
G. Ink Fountain Roller	O. Water Fountain Roller
H. Rubber Intermediate Rollers	P. Water Duct

Marked " A " in Fig. 2 is the impression cylinder, which is fitted with four cam operated grippers which clamp on the leading or gripper edge of the tinplate sheet as it is pushed into the point of registration by the rear sheet pushers. The rotation of the impression cylinder causes the grippers to pull the sheet through the machine between the top of the impression cylinder and the bottom of the blanket cylinder. The grippers hold the tinplate only until it is started between these two cylinders and then the gripper cam operates to open the grippers and release the sheet.

The impression cylinder is mounted in the printing machine side frames by eccentric bearings which permit the cylinder to be raised or lowered. Provided that tinplate sheets are being fed in a continuous flow, the impression cylinder will be in the up or " pressure-on " position, *i.e.*, applying pressure to and holding the sheet of tinplate against the blanket from which it is receiving the inked image.

Should the feeding of sheets cease for any reason, a small detector finger in the feed table is allowed to lift and through subsequent cam action causes the impression cylinder eccentric bearings to rotate and drop the cylinder away from the blanket. This action prevents the surface of the impression

(*continued in page* 462)

The Application of Vitreous Enamel by THE ELECTROSTATIC PROCESS

By S. HALLSWORTH*

A Paper presented at the Annual Conference of the Institute of Vitreous Enamellers, Chester, October 3 and 4, 1957

AS the result of the success of the Ransburg Electrostatic No. 2 process in the automatic application of paint and following requests from users of this process in the painting departments, Ransburg technicians turned their attention to the application of vitreous enamel by this method.

The difficulties at the outset can be readily understood when consideration is given to the different physical properties of vitreous-enamel slurry compared with paint. Paint, although not a true solution, is at least a mixture with each small particle of the pigment surrounded by an adequate amount of medium and solvent, whereas vitreous-enamel slurry consists of a suspension of solid frit particles in water. This difference in medium has delayed the introduction of the No. 2 Process to the vitreous-enamelling industry and has necessitated a considerable amount of work by engineers and technicians to bring it to its present state.

It may be advantageous at this stage to consider the development of the electrostatic process from its inception to the present day.

The early development of this process is a good example of highly technical industrial development following from the passing of a practical problem from the factory. It was in Ransburg's houseware's factory, which manufactures large quantities of kitchen and other metal goods, that the idea of applying the principle of electrostatic deposition to paint first arose, when it was determined to reduce the waste of paint occurring as a result of the high percentage of overspray always associated with hand spray painting methods.

No. 1 Process

The original electrostatic spray-painting process, using air-atomized spray, and now generally referred to as the No. 1 process, operates by introducing finely atomized particles of the required coating material from a specially modified type of automatic spray gun, operated by compressed air, into an electrostatic field where each particle receives a static charge. Through this same field is passed the work to be coated, the work being loaded on some form of conveyor and through it maintained at earth potential. As a result of the charge on the particles they are attracted to the work at earth potential in accordance with well-known principles and the thickness and uniformity of the coating film are controlled by adjustment of the spray guns and also of the position and method of hanging of the work-pieces relative both to the spray guns and to each other.

The electrostatic field is created in a simple type of spray booth, by a cage type of electrode to which a negative potential of low amperage is applied. This electrode consists of a series of fine wires supported on a light metal frame which is in turn held on insulators mounted on the spray booth.

The electrode is positioned to give a minimum practical distance between it and the work-pieces. There is also approximately twice this distance between the electrode and any other earthed object such as roof, walls or floor of the spray booth. The finely atomized spray coating introduced between the workpieces and the electrode at low forward velocity is attracted to the nearest earthed object which is the work-pieces themselves. The distance also controls the practical electrical potential to which the electrode can be raised.

When the finely atomized particles of coating material reach the electrostatic field they pick up a negative charge from the air ionized by the corona discharge from the wires of the electrode ; in consequence they tend to move along the lines of electrostatic force set up between the electrode and the workpieces. More precisely, the particles move along the resultant of the electrostatic force and that due to their forward velocity imparted by the air pressure used to atomize the coating material on leaving the spray gun.

The physical forces influencing the particles of coating material immediately before deposition on the article to be coated are, therefore, three in number, first the forward velocity from the spray gun, second that of the electrostatic field acting

*H. W. Peabody (Industrial) Ltd).

generally in a direction at right-angles to the first force, and third, gravitation force.

Further work indicated that greatly improved results could be obtained by spraying along the line of the workpieces on the conveyor rather than at right-angles to the line of the conveyor as in normal hand spraying, which was the method used in Ransburg's original experiments. By spraying along the conveyor two advantages arose : in the first place the spray remained in the electrostatic field longer than by the original method, and second, the coating film was built up gradually on each work-piece from the point at which it entered the influence of the field until it passed the spray gun.

The use of this process in the production of ceramic-coated steel tiles is illustrated in a recent issue of the " *International Enamelist*."

Since its development this process has been used to finish all types of items both with synthetic and ceramic materials. Although considerable efficiences could be obtained by using it, it still had numerous shortcomings. Air guns do not operate consistently over long periods, but change pattern due to plugging and air-pressure variations, particularly at the pressure desirable if the forward velocity already mentioned is to be kept low. These changes in pattern appear as film variations on the articles being coated, and it was felt that still greater efficiencies in coating material usage could be obtained.

No. 2 Process (Bell)

The next development represented a fundamental departure from all previous methods of applying coating materials to any surface. This method known as the No. 2 Process operates on the principle of feeding a controlled uniform supply of coating material to a point at which a highly concentrated electrostatic field is formed, the coating material having already been charged to the same high potential as the electrical source producing the electrostatic field. The electrostatic discharge in the first instance atomizes the coating material into extremely fine particles, finer, in fact, than can be achieved by other means ; second, the electrostatic field carries these particles across the intervening air gap and deposits them on the nearest earthed object, namely the work-piece.

A source of high-voltage, low-amperage, unidirectional, current is applied to one or more atomizing bells, which are in the form of bowls, having a sharp edge and an axial feed hole by which coating material can be fed to the inside surface. Mechanical arrangements are provided which ensure that the bells rotate at such a speed that a uniform film of coating material is spread over the inside surface of the bell and is fed at a controlled rate over this surface to the sharp front edge of the bell. The actual rate of flow of material is controlled to suit the area of surface to be coated per minute. The work-pieces are passed in front of each bell and generally at right-angles to the axis about which the bell turns and thereby provide the earthed object on which the coating material will be deposited from the bell.

No. 2 Process (Disc)

The disadvantage of the paint pattern from the atomizing bell on to a stationary flat sheet is that it forms an annular pattern which, of course, does not provide a uniform film coating if the flat sheet is passed in front of the bell at right-angles to its axis. To avoid this disadvantage, which necessitated the use of a combination of bells to compensate for the non-uniformity of the film produced by the single unit, the latest development of the Ransburg process employs a disc in place of the bell, to the centre of which the coating material is fed so as to be spread in a uniform film outwards to the edge of the disc. The parts to be coated are passed around the circumference of the disc and therefore through a uniform coating pattern.

The disc is electrically charged to high voltage with respect to adjacent articles so the coating material at its outer edge comes under the influence of this field. The material leaves the disc edge as a spray of fine charged particles and is directly attracted to the grounded work-pieces, (*see* Fig. 1).

Due to the high density of vitreous-enamel frit particles and the suspension agent being of an aqueous and so, highly conductive nature, it has been found that additional assistance must be given to the atomization of the material normally brought about by the electrostatic field. By increasing the speed of rotation of the disc equally fine atomization can be obtained to that attained for paint application. This improvement was only made possible after the principle of the atomizing disc as opposed to the atomizing bell had been established, since to increase the rotational speed of the bell would also increase the effect of centrifugal force which acts in opposition to the force of the electrostatic field depositing the enamel on the work. In the case of the disc, the two forces act in the same direction, and there is little disadvantage in increasing the disc's rotational speed.

It has, however, been found advantageous to provide high-voltage electrodes around the loop and behind the ware which repel any charged frit particles which might otherwise be thrown past the work as a result of the action of centrifugal force. The electrodes also increase the " wrap round " of the enamel on the edges of the parts being coated.

Since the spray pattern issuing from the atomized edge of the disc is relatively narrow in the dimension parallel to the axis of disc rotation, special tech-

niques are required to coat articles longer than about 4 inches in this dimension. Three such techniques are available :—

1. Reciprocation of the disc atomizer along the axis of disc rotation.
2. Inclination of the axis of disc rotation.
3. Use of a conveyor which causes the full length of the article to be drawn through the spray pattern.

In so far as vitreous enamelling is concerned the reciprocating disc has now been established as standard practice although The General Electric Co. of America still use the stationary disc with helical conveyor.

The reciprocating-disc method reduces the amount of conveyor necessary to carry the work round the disc. It provides a uniform spray pattern over the stroke, and the length of stroke can be readily varied to suit the size of articles it is desired to coat. Another advantage of the disc method is the extremely slow build up of the enamel coating during the passage of the parts round the circumference of the disc. In some applications there may be as many as thirty to forty passes of the disc applicator.

The disc atomizing unit and its rotating mechanism are mounted on the end of the cylinder cover which is, in turn, attached to the hydraulic ram rod. The hydraulic cylinder is mounted inside a main pedestal tube and bearings attached to the cylinder cover guide the reciprocating movement over the full length of the stroke.

The power for reciprocating is supplied by a hydraulic pressure assembly consisting of an electric motor coupled directly to a vane-type pump mounted above hydraulic oil reservoirs. Filtered oil is drawn into the pump and then through various valves to motivate the ram.

A cable-operated stroke control mechanism is used to control the reciprocating stroke by means of micro-switches which supply current to energize solenoids on the main control valve. Adjustable chokes are fitted in the main valve assembly to prevent reversal shocks. To control the speed of reciprocation a flow control valve is incorporated and arranged to bleed-off the pressure oil directly from the main delivery line. As the cylinder is designed so that by having as nearly as possible equal differential areas, its speed of travel is maintained constant in either the upward or downward direction.

Due to the abrasive action of ceramic materials a diaphram pump is used to prevent any contact between the slurry and moving metal components. A variable-speed unit is incorporated and the speed of the pump can be adjusted to supply the requisite controlled amount of slurry required. Adjustments of pump output and speed of conveyor travel enable the thickness of coating to be varied or controlled to very fine limits.

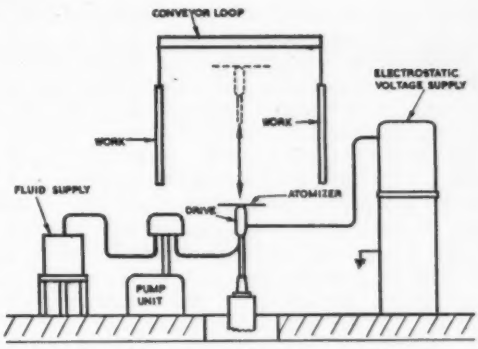


Fig. 1. Diagram of No 2 Process (Disc).

As already stated, vitreous-enamel slurries are highly conductive owing to their water content, and special arrangements have to be made to ensure complete insulation of the enamel, pump and feed lines.

Enamel and Milling

As a general rule no modification in frit formulation is required from those used by conventional methods. The same type of frit, clay and electrolyte is used in the application of enamel electrostatically as is used for application by hand or automatic spray guns. Some modification is, however, required in milling formulae and in the physical properties of the slurry.

It has been found desirable to mill the enamel much more finely than normally, and the enamel usage is proportional to the fineness of grinding. Finenesses of 0.2 to 3.5 gm. retained on a 400-mesh screen have given satisfactory results, with a tendency to tearing on the fine limits and a slightly reduced overall efficiency with the coarser ground material. A compromise between the two finenesses gives optimum results.

In view of the fine grinding required the normal sieve-test method is not universally used, and recourse has been made to the Hegman Scale. This consists essentially of a plate in which grooves of varying depths are cut. The enamel slurry is passed over the plate by means of a scraper and the depth or size of the frit particles can be ascertained from the appropriate groove, and reference to a scale will give what is known as a " club unit." Another fineness control test is also being widely used in the States, referred to as the " Settling Test." This test is not intended to determine particle size, but rather to act as a control test based on a reference or standard determined by experience. The procedure for the test is as follows :—Measure 70 ml. distilled water into graduated cylinder, add 3 ml. of sodium-silicate solution, prepared by diluting 2 cc. of

40°Be. material with 3 ml. of distilled water, and fill to the 100 ml. mark with enamel slurry having a specific gravity of 1.69 to 1.71. Add 1 ml. of phenolphthalein solution as an aid in determining the level of the settled solids. Stopper cylinder and agitate thoroughly for 20 to 30 sec. by shaking and inverting, allow to settle. Read and record volume of solids settled at 2-minute intervals for a total of 12 minutes. In actual production use of the test, the total volume settled during some standard length of time (*e.g.* 10 or 12 minutes) is taken as the end point of the test.

As stated previously, the major defect of fine grinding is tearing, and this can be controlled by the addition of urea or sodium nitrite or both. It is interesting to note, however, that experience has shown a far less tendency to tearing with enamel applied electrostatically than by normal spray-gun methods using enamel ground to the same degree of fineness. It is thought that the high amount of atomizing air necessary in a regular low-pressure or high-pressure spray gun aggravates this tendency.

Due to the fineness of grinding, an increase in milling time is required, but this can be off-set by using high-density grinding media.

In practice the use of high-density grinding media results in very little more time being required to grind the same amount of frit to the necessary fineness than is required for standard grinding with normal media. It is also important to note that less enamel is required and the increased opacity obtained from fine grinding is very beneficial in a process where exceptionally thin coats can be applied.

As will be seen from Table I, in the milling formulae which are at present in use, no great deviation has been made from standard practice, with the possible exception of the urea or sodium nitrite additions, which may be somewhat higher.

Slurries with specific gravity ranging from 1.5 to 1.7 and pick-up weights of 40 gm. per sq. ft. to 100 gm. per sq. ft. wet, have been used. In general, however, and under normal conditions, the specific gravity will range between 1.60 and 1.65 and the pick-up weight between 60 and 90 gm. per sq. ft. wet. The relative humidity in booth atmospheres does have an effect on the electrostatic application, but this can normally be controlled by variations in specific gravity and set of the enamel slurry, low-gravity high-set slurry being used at low humidities, and high-gravity low-set slurry at high humidity.

With carefully controlled slurry, 95 to 98 per cent of the enamel used is deposited on the work itself. Due, however, to the electrostatic attraction, a certain amount of enamel is deposited on the back of the ware, and this amount is dictated to some extent by the amount of wrap-round required. Specific gravity and set also has an influence on this deposition. With certain articles this deposit can be used to build up the coating on alternative planes, and work is proceeding to utilize the deposit on flat flanged pressings.

Table I

	A.	B.	C.
Frit	100 lb.	100 lb.	100 lb.
Clay	4 „	4 „	4 „
Bentonite	9½ oz.	8 oz.	6 oz.
Sodium aluminate	2 „	3 „	3 „
Potassium Carbonate	3 „	3 „	3 „
Sodium Nitrite	2½ „	8-12 „ *	8 „ *
Gum	1 „	1 „	1 „
Urea	12 „ *	—	4 „

* Added in solution form after milling.

The spacing of parts on the conveyor is also very important. If there is too much space between the parts, build-up will occur on either side of that space, but the distance between parts must be adjusted to ensure any wrap-round required at the edges of parts.

With regard to weight of deposition, it is believed that if the ground-coat is applied to a sufficiently high standard of quality it should be possible to reduce the weight of deposition of cover coat to about 22 gm. per sq. ft. with present-day titanium enamels. Figures of 24 to 25 gm. are being obtained in large-scale production. Should future frit developments produce even more opaque enamels, the above figures could be reduced accordingly.

There appears to be no substantial difference between the application of normal enamels and low-temperature fusing or one-coat enamels direct on steel, providing these materials are treated in the correct way for electrostatic application.

Limitations exist in the matter of electrically-shielded areas. Deep-well parts, refrigerator liners and the inside of washing-machine tubs cannot be coated by this process by reason of the electrostatic effect on the edge of the deep-drawn pressing.

Equipment

Apart from the conveyor which, as previously indicated, is necessary for the operation of the process, the specialized equipment required for a complete installation consists of a high-voltage transformer in which is incorporated full-wave rectification. In this country metal rectifiers are used, whereas in the United States valve-type rectifiers are preferred. The operating voltage can be adjusted in the light of experience to suit the requirements of each particular application, but is normally about 90 kV. Primary volts to the transformer are supplied through a control system which limits the high-voltage output to between 2 to 2½ milliamperes. This is done to ensure complete safety to personnel.

(*Continued in page* 464)

CONTINUOUS SURFACE PRETREATMENT PROCESSES

with particular reference to "NITEC" SHEET FOR VITREOUS ENAMELLING

An Account of Practice at the Shotton Works of John Summers and Sons, Ltd.

by W. H. F. TICKLE and D. A. WINTON

(*A Paper presented to the Annual Conference of the Institute of Vitreous Enamellers Chester, October 3 and 4, 1957*).

A YEAR or two ago F. H. Smith presented to the I. V. E. Summer School a paper on Nitec sheet, dealing particularly with the processes used in the manufacture of Nitec, its properties and the benefits likely to be derived from its use.

While in the intervening period much progress has been made on the development of Nitec, it was felt that it is, as yet, somewhat early to present a further full length formal paper on Nitec.

It is proposed, therefore, to adopt a possibly unsual procedure, and to show a film dealing with what are termed pre-coated sheets, their usage and the benefits arising therefrom.

The pre-coated sheets, of which Nitec is an example while, perhaps a novelty as regards vitreous enamelling, are widely used in a great many other industries. It is thought, therefore, that knowledge of the practices adopted by those industries in the use of pre-coated sheets might be of interest to enamellers in adjusting any techniques that they employ in sheet-metal usage, should the use of pre-coated sheet that is Nitec, become widely adopted. Such knowledge will perhaps allay any fears that may persist concerning the fabrication of coated steel sheets.

At this stage, it might perhaps be as well to define what is meant by a precoated sheet.

The definition as generally understood is that of a steel sheet coated at the steelworks with a coating that protects the steel from corrosion during transit, storage and after fabrication. The coating usually forms an integral part of the surface finish system, in some instances by itself, or as is most frequent as the basis for painting.

Nitec consists essentially of an enamelling grade sheet-steel base, produced in a basic open-hearth furnace and rolled by the continuous wide strip mill process. After annealing and cleaning it is subsequently coated with a deposit of nickel and a further protective deposit of zinc.

The reasons that have prompted the development work on Nitec are first the provision on top of a consistent base material, of a surface which will itself be consistent as regards surface finish, second a surface which will require only the minimum of treatment by the enameller, and third the ultimate goal of a one-coat enamel.

Generally speaking, and without reflecting on the technical efficiency of the smaller producers, it is cheaper and easier to treat material in flat form and in large quantities by a continuous process, than singly in small numbers in several different works. The result, therefore, will be to transfer to the works at Shotton much of the cleaning and surface preparation now carried out by the sheet users. This should give an improved product, including better adhesion and the use of a single-coat enamel, and reduced costs to the manufacturer. The number of rejections also should be substantially reduced. Experiments to date, with Nitec, indicate that it should be suitable for a one-coat self-mottling enamel. These experiments with frits of various manufacturers are proceeding. It is hoped eventually to produce Nitec so that it will take a single-coat enamel of any colour .

In the preparation of Nitec, the sheets, after rolling and annealing, are degreased, pickled and cleaned. The next stage is the application of a nickel coat and then finally the protective zinc coating. The reasons for the nickel coat are well known, but it might possibly be helpful to give the reasons for the application of the zinc coating.

As is generally known, zinc by means of the hot-dip galvanizing process has long been used for protecting most forms of steel, including sheet. In latter years, the electro-deposition process has been employed at Shotton for coating steel sheets with a thin coating of zinc. These sheets, under the name of Zintec, are used for all manner of purposes including cranes, kitchen cabinets, refrigerators, railway coaches etc.

The reasons for the choice of zinc as the protective medium in these Zintec sheets are several perhaps the most important being that should the coating be damaged in any way to expose the steel base, the zinc will sacrificially protect the steel from corrosion.

During the various sheet fabricating processes

a zinc-coated sheet behaves very similarly to an uncoated sheet. While some greater care is obviously necessary during welding processes to prevent damage to the coating, the basic underlying techinque is unchanged. Electro-zinc coated sheets are spot welded, seam welded and gas welded with ease. In deep drawing, the zinc coating does in fact appear to assist the drawing process.

The protective of zinc is of considerable advantage in preventing rusting of the sheets during storage and during all stages of manufacture. The cleaning is the minimum necessary. Protection against rust during storage is for both sheet and fabricated article, most important. Articles made from pre-coated sheets may be kept for many months without deterioration.

All these reasons for the choice of zinc apply for pre-coated sheets such as Zintec where the coating is retained in the finished article. They also apply for sheets such as Nitec, where the zinc coating is removed prior to enamelling. Tests with Nitec on welding and deep drawing confirm this. The zinc protects the nickel from abrasion during the latter process and also appears to lengthen the life of the drawing tools.

Removal of the zinc coating during pickling to reveal a chemically clean nickel surface ready for enamelling is accomplished in a very much shorter time than is necessary for pickling the usual type of enamelling grade sheet.

Dealing in a little more detail with the fabrication and use of Nitec, experiments have been carried out with an inside oven liner. These experiments show that the material can easily be worked. The zinc coating acts in assisting mechanical operations, as mentioned earlier, in the following manner :

It protects the prepared nickel film from mechanical damage.

It acts as a protection during transport and storage in sheet form and also during storage of the semi-finished part.

Its surface decreases wear on the tools and thus enhances tool life.

During pickling, the zinc coating is rapidly removed in 3 minutes compared with what is assessed as an average time of 20 minutes for the pickling of ordinary enamelling iron. The removal of the zinc reveals the nickel flashed surface ready for enamelling. The important point about this is that no additional operations are necessary ; in fact, the duration in time for treatment processes can be reduced. For welding also, Nitec can be welded by all accepted methods but long-term research is being carried out on the best methods for specific applications.

For deep drawing, no special tooling is necessary. The tools normally used for the standard enamelling steel are unlikely to need modification. It is, however, important to mention that some drawing lubricants are acidic and will react with the zinc surface. While this is not detrimental if the article is to be degreased immediately after deep drawing, storage of the semi-finished part would probably give time for corrosion to occur. The lubricants concerned include sulphochlorinated oil, olein soap, chlorinated hydrocarbons and organic sulphur compounds.

Dealing next with processing in the works, the process adopted for the oven liners prior to enamelling were degreasing in trichlorethylene followed by sodium orthosilicate ; the zinc film was removed by immersion in 10 per cent hydrochloric acid for two minutes, followed by rinsing and neutralizing.

It is suggested that the use of a coated sheet such as Nitec should lead to considerable economies. Apart from savings in pickling costs there should be a considerable decrease in the number of rejects.

Rejects can take place at various stages of production and the greater the number of operations the greater the rejection risk. The use of Nitec not only reduces the number of operations, but also provides a consistent base material with a consistent surface. The protective zinc film, preserves what is a specially cleaned and prepared surface with a controlled nickel film and it can, therefore, be classed as a steel which will have a uniform and consistent surface when the enamelling stage is reached.

There will also be an improvement in the finished product. It is reasonable to suppose that consistent adhesion will follow from a consistent surface and a uniform controlled nickel flash unaffected by the contours of the finished pressing.

The possibility of using single-coat enamels offers perhaps the greatest economy. The use of Nitec for single-coat finishes is being investigated by the frit and colour manufacturers, and at Shotton into its potential as a surface for single coat finishes.

It is hoped that what has been said in this brief paper has shown that a considerable amount of work is proceeding in this country in an effort to produce an improved sheet steel for enamelling and one that will take a single coat. Given this base material considerable economies should be open to the enamelling industry.

Discussion

Opening the discussion MR. JOHN HOOPER said that enamellers should feel grateful at the prospect of a large number of their worries being taken over by an organization which was better equipped to deal with them than were some enamellers. In view of the troubles which arose from pretreatment,

if it was possible on a mass-production scale for all the troubles of descaling and cleaning to be assumed by the suppliers of the sheets it should certainly result in a reduction in the number of rejects.

With regard to the actual effect of the nickel coat on Nitec, there had been evidence in recent months of the value of a nickel coating produced by a nickel dip, where the nickel was deposited by chemical reduction on the surface. He would have thought that the properties of the nickel so deposited would be very different from those of the nickel coating produced by electrodeposition. Had Dr. Tickle any views on whether or not that difference in the physical condition of the nickel would have any effect on the enamellability of the sheet ?

Dr. Tickle replied that it mattered a great deal in what form the nickel was deposited on a sheet. In a brief paper which he had delivered to the 1955 conference in Manchester he had given an indication of certain work which had been done and what had been found to be various optimum coating levels, whether the nickel was deposited by electrodeposition or from the type of bath used by enamellers. The optimum thickness of the nickel had to be determined for each form in which the nickel was deposited on the sheet. If the nickel was afterwards activated by any process, the accessible surface area of the nickel could be vastly enhanced. It therefore mattered in what form the nickel was deposited. That was part of the work which they were doing to get a one-coat enamel on steel and was the concern of workers in almost every process which aimed at producing a one-coat finish.

Mr. B. B. Kent said they had found that they could use enamel successfully on Zintec. He presumed that a small quantity of the zinc was removed in pickling.

Dr. Tickle said that most of the Zintec which was produced and distributed was alleged to have a coating thickness on it of 0.0001 in. They always tried to deposit a little more than that, to provide a little extra in case there were any complaints, but Mr. Kent was right in assuming that pickling would remove that.

Mr. S. E. A. Ryder asked how Dr. Tickle felt that the Nitec sheet compared both in cost and particularly in enamellability with well-controlled nickel-dipped articles.

Dr. Tickle, said that this was a difficult question to answer, but that at present they felt that, with the tonnage envisaged, they could produce a sheet which would be quite competitive, at current prices and current costs of production. It might be thought that that did not offer any advantage to the enameller, but if the enameller used his nickel tank only, on one or two days a week it was a nuisance to have to start it up for only a portion of his production. If, on the other hand, his shop was fully occupied with such work, it would not be possible to offer him any cost advantage. It was a question of the tonnage which it was possible to sell. At the moment they estimated that it was possible to break even and to offer an advantage to shops which were not at present equipped for nickel flashing, and also to those which used it on certain days of the week only, when it did not pay to start the job up for a limited proportion of the production. In time they hoped to get below what were the production costs of the trade at the moment.

On the question of enamellability, initial reports indicated that the performance was as good, but he was very well aware that in Mr. Ryder's own shop, a very high standard indeed was set and maintained.

However he did not think that any distortion of the facts was involved in saying that the enamellability of Nitec was well up to accepted commercial standards at the moment.

Mr. A. H. Symonds suggested that resistance to chipping of the enamel was a function of how thick the coating of enamel was. Would the authors agree that they had still some way to go in getting as good an appearence with Nitec as could be obtained with a good nickel dip ?

Dr. Tickle said that thickness for thickness, they were able to achieve the usual commercial standards with Nitec and expected to be able to improve on them in the future.

Mr. J. Semple said it seemed dangerous for the enameller to depend on a specially prepared sheet for the direct application of cover coats. He remembered doing experiments two or three years ago with earlier Nitec steels in which there was considerable evidence that, despite the zinc coating, the pressing process had damaged the nickel coating, and the bond was almost non-existent in certain areas. Had that position been cleared up ? Also, the reference to applying cover coats to a specially prepared sheet seemed to him to dismiss too lightly the fact that what had to be done afterwards was to press it, degrease it, remove the zinc, neutralize it and then put the cover coat enamel on. That was the difficulty which faced the industry at the present time : a lot of processes had to be carried out on a sheet prior to applying the enamel coat, and the use of a prepared sheet would not necessarily solve the problem of obtaining a chemically clean surface on a finished component.

Dr. Tickle thought that it would solve the problem. On a sheet which was chemically clean, sealed, and then subject to the rigors of the press shop, there would at least be a parting film of zinc which could be removed with all the debris from the press shop and there was every indication that that was what was achieved in practice.

Moreover, if there was not a one-coat enamelling

(*Continued in page* 464)

2nd CONFERENCE OF EFCO-UDYLITE DISTRIBUTORS

Three-day meeting in Weybridge

THE second three-day technical conference of Efco-Udylite overseas distributors was held in Weybridge from October 2nd to 4th. Visitors included Mr. L. K. Lindahl, chairman of the board of the Udylite Corporation, Dr. H. Brown, Udylite research director and representatives from the following firms in twelve countries : Dr. H. Steiger, Austria ; Ets. R. Corbiere & Cie, Belgium; J. A. Wallin, Denmark ; Ste. Continentale Parker, France ; Firma Friedr. Blasberg, Germany ; Plating Chemie, N.V., Holland ; Industria Metalchimica ; Ing. A. & F. Stein, Italy ; Haral A. Johansen, Norway ; Chemical Services Pty. Ltd., South Africa ; Instituto Electroquimico S.A., Spain ; A. B. Tudor, Sweden ; Ets. Lux A. Raymond & Cie, Switzerland.

The Conference was opened by Mr. D. F. Campbell, Chairman of Electro-Chemical Engineering Co. Ltd. A full programme included a number of technical papers and a film of the Udylite automatic bumper bar plating plants, the largest in the world, built for the Ford Motor Co. at a cost of 12 million dollars. Visits were arranged to the company's Works at Sheerwater and to Norman Hay Ltd. and Hoover Ltd., High Wycombe, to study Efco-Udylite automatic plating installations.

Two of the papers presented at this meeting are published in the following pages of this issue, by permission of the Electro-Chemical Engineering Co. Ltd. and others will appear in subsequent issues.

The undoubted success of this conference should do much to raise the standard of technical knowledge throughout the Efco-Udylite overseas organisation, to encourage the interchange of information about metal finishing matters and to promote even closer co-operation between all the companies concerned. This should ultimately benefit users of Efco-Udylite plants and processes everywhere.

Pictured on the right are some of the representatives at the Conference showing (from top to bottom and left to right) Dr. H. Brown (U.S.A.), Mr. H. L. Greenwood (U.K.), and Mr. K. Sommer (Germany) ;
Mr. J. Prier (France), Mr. J. Corbiere (Belgium), and Mr. L. Ades (France) ;
Mr. I. Ericson (Sweden), Dr. J. Odekerken (Holland), and Dr. A. Hoch (Germany) ;
Mr. R. Corbiere (Belgium), Mr. H. J. Bache (U.K.), Dr. L. K. Lindahl (U.S.A.), Mr. Dete (France), Dr. A. Hoch (Germany) and Mr. H. Silman (U.K.).

ACID COPPER PLATING
with particular reference to the use of
THE UBRYCO PROCESS

By M. R. MARSHALL*

(A Paper presented to the Distributors' Conference organized by the Electro-Chemical Engineering Co. Ltd., at Weybridge, October 2, 3 and 4, 1957)

THE merits and demerits of acid copper plating as opposed to cyanide copper are fairly well known. The chief disadvantages of acid copper are the necessity to apply a copper undercoat from a cyanide solution when plating steel components, and also that acid copper solutions have poor throwing power. In addition to the poor throwing power the acid electrolyte tends to attack deeply recessed steel-work in extreme low-current-density areas where no deposition occurs.

These limitations dictate the applications of the process. First it is only suited to applying heavy deposits, for example, 25 microns and above, and second the work must be of fairly simple shape with no deep recesses.

The Ubryco semi-matt acid copper plating process however is extremely easy to polish and there is no tendency for the copper to drag on the polishing mop, but, at the same time, it can be made to flow into small pits and scratches reproduced from the base metal. The organic addition agents impart sufficient hardness to the deposit to prevent cutting through, except by extremely heavy pressure on the mop.

A certain amount of levelling does occur during plating and while this may not be as good as is obtained with some of the recently developed nickel solutions, it is noticeable to the eye on comparision with deposits from cyanide solutions prepared on similar base material.

The best application of the process is to provide a surface which may readily be polished to a mirror finish on medium finished steel base metal.

Examples of the type of work to which the process is applicable are automobile components, such as bumper bars, hub caps and decorative trim, cover plates on domestic appliances, for example :— electric irons, toasters, etc., and generally on decorative sheet-metal components with external areas requiring a high standard of finish. It is not generally suited to tubular work, unless the tubes can be stopped off easily and efficiently to prevent ingress of the solution. Articles such as lamp reflectors would not normally be plated in Ubryco, as the surfaces requiring a polishing operation are internal and the distribution of the deposit would be uneconomical. Generally speaking an average deposit of 25 to 50 microns of copper is applied, but on a reflector this would only give a thickness of about 5 microns at the centre of the bowl, unless internal anodes were used.

A process similar to Ubryco has been used in the plating of plastics. The advantage of acid copper in this respect is that the solution operates at room temperature and does not set up thermal stress between the metallized coating and the plastic base.

In certain cases, where the purpose of the copper deposit is solely to save nickel, the Ubryco deposit may be directly nickel and chromium plated. However, the appearance and corrosion resistance of such a deposit is inferior to that obtained on polished copper.

From the point of view of cost, Ubryco copper compares favourably with cyanide copper. The initial cost of plant may be somewhat higher, since Ubryco requires an acid-resistant tank lining and a tank equipped for air agitation and filtration, but some of this cost is offset since fume exhaust and heating are not required in the main plating tank. The running cost of the solution should be lower than for cyanide copper solution, as copper sulphate and sulphuric acid are considerably cheaper than copper cyanide and Rochelle salt. Also, in running a cyanide copper solution, it may be necessary to discard part of the solution periodically to avoid carbonate build up. Experience has shown that there is no reason why a Ubryco solution should not run indefinitely without discarding any of the solution. Under normal conditions the slight increase in copper content, due to chemical dissolution at the anodes, is balanced by drag-out and organic impurities are removed by periodic carbon treatments. The solution is tolerant to most of the inorganic contaminants likely to be encountered.

The normal solution composition is satisfactory up to about 30 amp per sq.ft. At higher current densities it is generally necessary to operate the solution at a temperature of 35°C., or better to use an alternative basic solution containing 220 gm. per l. copper sulphate and 20 gm. per l. sulphuric acid. In practice it has not been necessary to use a non-pitter.

*Electro-Chemical Engineering Co. Ltd.

In the 1954 Proceedings of the American Electroplaters' Society, *Nevers*, *Hungerford* and *Palmer* suggest the use of phosphorized copper anodes to reduce the formation of anode particles in acid copper plating solutions. The author's experience of this type of anode is very limited, but they would probably be satisfactory for use in the Ubryco process.

Rubber-lined pumps have been found satisfactory for continuous filtration of the solution. Nylon anode bags and filter cloths can cause serious organic contamination and are not recommended. Terylene anode diaphragms are preferred to anode bags, though the latter are satisfactory providing the cloth is not too closely woven.

If the process is used continuously it is generally found that the chloride ion concentration of the electrolyte decreases slowly. Hence it is generally necessary to make small weekly additions of chloride and only in rare cases has it been necessary to remove chloride from the solution.

The consumption rates of the two brighteners vary with the rate at which the solution is used. If the process is used only occasionally with intermittent periods of inactivity, the brightener consumption will be considerably lower.

In order to maintain consistent, trouble-free operation of the process, it is recommended that a portion of the solution say, one third of the total volume, is carbon treated once every 2 to 3 weeks, this procedure being more satisfactory than treating all the solution at less frequent intervals. Small concentrations of the breakdown products from the brighteners are beneficial in maintaining a uniform deposit. The frequency with which carbon treatments should be carried out is best decided in individual cases. Prior to adopting the procedure outlined above it was recommended to carry out a complete carbon purification treatment at three-monthly intervals. This worked well in practice, but occasionally there was a little trouble in operating the bath immediately following the carbon treatments. Once the brighteners had been worked in, the process operated satisfactorily. Using the partial carbon treatment technique outlined above, this difficulty has been eliminated.

Since there are no analytical methods for the brighteners, it is necessary to carry out rolled cathode plating tests to determine what additions are required ; this method works well in practice. It is rather better than judging what additions are required from the appearance of the work in the main plating tank. In order to reproduce fault conditions in a small cell it has been found that an air-agitated Hull Cell is very useful as by its use it is much easier to detect striations. As with nickel solutions it is better to use the two tests in conjuction for detecting and eliminating faults. For everyday maintenance of the solution, however, only the rolled cathode test need be used.

A brief description will now be given of some of the troubles which may be encountered with the Ubryco process.

Roughness may be caused by small metallic particles in the solution which may be introduced from a number of sources, particularly, the anodes. These exist as extremely fine copper powder which dissolves quite quickly in the air-agitated solution. The purpose of the anode bags is to keep the solution relatively static in the region of the anodes, thus giving time for most of the particles to dissolve before reaching the main body of the solution. It is for this reason that anode diaphragms are preferred to anode bags. If, however, the diaphragm or bags are damaged, particles may be carried to the cathode. The larger particles will cause settling roughness, while particles which are almost completely dissolved may cause a general hazy appearance of the deposit particularly noticeable in high-current-density areas.

Other sources of roughness are carbon or silver chloride particles, introduced by inadequate filtration after a carbon or silver sulphate treatment. Silver chloride is very detrimental in this respect since it also causes large deep pits in the deposit, even when present in very small quantities.

Carbon is less harmful and small amounts are tolerated in the bath. Nevertheless, it should be removed as soon as possible as it will cause increased brightener consumption.

Steel articles which fall from the jigs during plating may dissolve slowly in the solution, precipitating copper powder. Normally this does not cause any trouble since the powder is coarse and heavy and it usually lies below the level of the agitation pipes, so that it is not thrown up into the main bulk of solution.

High-current-density burning of the deposit may be due to the solution being too dilute, or to a lack of brightener.

Anode polarization, indicated by a rise in voltage and decrease in current while work is being plated, can be caused by unsuitable anode bags, lack of sulphuric acid or by using too high an anode current density.

Pitting may arise if the metal concentration is very low. Other causes are lack of brightener, organic contamination and particles in the solution. Pitting will also occur if the cyanide pre-copper deposit is too thin, porous or pitted, or if the basic metal is pitted.

Striations are a form of defect which appears to be peculiar to acid copper. Little is known about the fundamental cause of this fault beyond the fact that it is due to some form of cathode polarization. The defect may appear in a number of forms.

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Some Notes on LIQUID POLISHING COMPOSITIONS

by R. G. HUGHES*

(A Paper presented to the Distributors' Conference organized by the Electro-Chemical Engineering Co., Ltd., at Weybridge, October 2, 3 and 4, 1957).

SINCE the beginning of this year when the author's company commenced operations in the field of liquid polishing compositions, steady progress has been made and initial problems, both of manufacture and of application are gradually being resolved. With the exception of one or two special abrasive powders, suitable raw materials have been found in this country and a mixing machine having a capacity of 2,000 lb. per mix has now been installed at Sheerwater. Although the volume of sales is as yet rather low, it is expected that in the near future, the extensive preparatory work which has been carried out on this project will show a considerable increase in business.

It appears that a certain amount of misunderstanding has arisen, particularly in Europe concerning the various terms used to describe the different stages or processes used in preparing a metal surface for electroplating and, therefore, these will be first explained. In this country the term " polishing " is used to include the whole operation of giving a metal surface a smooth brilliant finish good enough to apply a bright electroplated coating such as bright nickel or silver. This polishing operation can be broken down into various subsidiary processes as follows :

Polishing

Emery-bobbing.

This is carried out on felt wheels dressed with glue and emery powder and is only used when the initial surface is very poor and rough, for example sand castings, badly scaled or pitted steel, or to remove " flashes " from die-castings. Various sizes of emery are used, from as low as 60 mesh up to the finest flour emery, depending on the initial surface and the final finish required. On occasions, 2 or 3 different grades of powder are used in turn for a progressive smoothing. The process can be carried out dry or with the application of a small amount of grease such as tallow etc.

Linishing.

This can be used as an alternative to bobbing and is carried out on prepared emery or aluminium-oxide belts in conjuction with various backing wheels such as felt calico etc. These belts are obtainable in various abrasive sizes and can also be used with the addition of grease.

In the U.S.A. the above two processes are known as polishing.

Mopping or Grease-Mopping.

This is usually carried out with a tripoli composition used on either a stitched calico mop or a coarse air-flow mop, particularly for non-ferrous metals. With ferrous metals such as mild steel or stainless steel it is now becoming usual to use an aluminium-oxide composition in conjuction with a Sisal mop or a tampico brush. It is used to obtain a further smoothing of the surface imperfections without necessarily obtaining a high lustre or brilliance.

In the U.S.A. this is known as buffing.

Colouring.

This is usually carried out with a lime or very fine aluminium-oxide composition on either a very fine calico air-flow mop or loose-leaved calico or swansdown mops and is used to give a high lustre or brilliance to the surface. Often in this country it is performed after solvent degreasing.

In the U.S.A. this process is also known as colouring.

When, therefore, a composition is referred to as having good " cutting " properties, this means that the composition will give rapid smoothing of imperfections in the surface without giving a high gloss or brilliance. With a " cut " and " colour " composition, fairly rapid smoothing and a reasonable lustre would be expected. A colouring composition is used to give a final brilliance to a surface which is already smooth and free from imperfections.

The advantages to be gained in using liquid compositions are quite substantial and the principal ones are briefly :

1. With liquid compositions all the composition is usable, there are no bar ends or nubbins to be discarded or remelted and remoulded. This is particularly so on automatic equipment, where many different widths of mops are used and only a very limited number of widths of bar composition are available.

2. Used in conjunction with proper spray equipment, the liquid compositions are applied automatically, or in other cases by means of a foot-controlled valve. In either case there is a saving of time and labour because of the extreme ease of application.

*Electro-Chemical Engineering Co. Ltd.

3. In most cases less composition is used. The spray equipment can be easily adjusted so that just sufficient composition to do the job efficiently is applied. The adjustment can readily be made to control the amount of composition per application to a fraction of a gram. Frequency of application can also be regulated (with an automatic installation) over a very wide range to a time of a fraction of a second.

4. The better control of frequency and amount of composition applied to the mop, results in a more uniform composition head on the mop and consequently mop wear is considerably reduced. In this country so far, increase in mop life of up to 150 per cent has been obtained. It has also been established that mops run much cooler when emulsion-type compositions are used in place of bar compositions.

5. A much larger scope in formulation is possible in the manufacture of liquid compositions. It is therefore possible to vary the formulations to give exactly the properties required over a wide range of metals and conditions, to obtain the highest possible degree of finish for the least cost.

6. Liquid compositions have now been developed which are extremely stable over a long storage life, present no problems in "settling out" and which have a very high flash point, thus reducing considerably the risk of fire.

7. The cost of spray equipment for automatic machines is considerably less than that of solid bar applicators, and it is possible to instal containers which need re-filling only after fairly long intervals. This eliminates the necessity for stopping the machine to insert new bars of composition, thus increasing the production efficiency of the polishing machine and avoiding any break in a production run.

8. This combination of application labour saving, buff wear reduction, composition cost saving and increased production efficiency results in substantial savings in the total cost of finishing.

9. The use of emulsion-type liquid composition eases the problem of cleaning after polishing prior to electroplating. The use of emulsified greases very often eliminates the necessity for expensive solvent degreasing, thus saving labour costs in subsequent operations.

It can be seen, therefore, that a considerable overall saving in cost should be possible by the use of liquid compositions, and although at present, no definite figures are available in this country, it is already established that savings are being made in installations already made.

The author's company has limited the number of formulations now being offered in this country to eight and the following is a list of these :

Liquid Compositions

For Ferrous Metals.

For ferrous metals three compositions are available, the first being a steel-cutting composition with very heavy cutting properties. Used in conjunction with sisal mops on ordinary and stainless steels, this composition will normally give a surface finish suitable for copper plating on steel. To give a fully lustrous finish suitable for plating in a bright nickel solution it is necessary to follow with a colouring operation.

The second composition gives a medium cut and fair colour, and can be used as a cut-and-colour composition on stainless steels where a medium-quality finish is required. It is normally used on either a sisal or a stitched mop, depending on the finish required.

The third composition, for steel, gives a light cut and good colour; it is used as a cut-and-colour composition where the base metal surface is reasonably good and a good lustrous finish is required.

For Non-Ferrous-base Metals and Electro-deposited Coatings.

In this field five compositions are available. The first is a liquid tripoli composition with very good cutting properties. It is used for heavy mopping with stitched calico or coarse air-flow mops on all non-ferrous-base metals. It does not give much lustre and is normally followed by a colouring operation.

Another liquid tripoli composition which provides a medium cut and a reasonable lustre is used for mopping non-ferrous metals where the base metal surface is reasonably good and lighter cut is required for smoothing. It is a possible cut-and-colour composition for medium-quality finish.

The third liquid tripoli composition has a good cut and very good colour and is used on air-flow mops for single-operation cutting and colouring, particularly on zinc-base die-castings. It can also be used for finishing electro-deposited coatings such as copper and nickel, in one operation.

The last type of liquid tripoli composition has very light cutting properties and gives a very good colour. It can be used on fine air-flow or calico mops as an alternative to a lime finish for colouring all non-ferrous metals and for finishing semi-bright electro-deposited coatings.

The first liquid colouring composition mentioned as giving excellent colour, particularly on steel and stainless steels, has very little cut and can also be used to give a high lustre on all non-ferrous metals.

While the compositions outlined above cover a fairly wide field the possible variations in formulation are very wide and the author's company has already been asked to match a competitive liquid

composition which has been obtained by an English company from the U.S.A.

The application of liquid compositions to the polishing wheels is relatively straight-forward, although there are certain basic principles to be followed. The equipment is similar in most respects to a paint-spraying set-up, except that the spraying nozzles are usually slightly larger in diameter. For an automatic set-up the equipment consists of :

1. The required number of automatically controlled spraying guns. Normally each gun will cover a mop width of up to 4 in. and should the working width of the mop exceed this figure, two or more guns are required to cover the mop efficiently and economically.
2. A pressure vessel containing the liquid compositions, which can be one, two, five or more gallons according to the size of the set-up.
3. A variable timing device for controlling the frequency of application and the amount of composition applied.
4. Necessary air valves and pressure tubing both for air and composition.

Suitable guns and equipment can be obtained from Alfred Bullows and Sons Ltd. of Walsall and the guns are fitted with a 0.07-in. diameter nozzle. They are completely air operated and give a spray pattern which can be varied slightly from an ellipse to a complete circle depending on the width of coverage required.

Normal working pressures are :

(a) Trigger operation—approx. 80 lb. per sq. in.
(b) Composition feed—35 to 40 lb. per sq. in.
(c) Atomisation feed—35 to 40 lb. per. sq in.

The gun is mounted within 2 to 3 in. of the edge of the mop and as near to the actual contact point between the mop and the component being polished as possible, preferably within a 90-deg. arc of the contact point. It is also mounted so that the jet of composition impinges on the mop at a slight angle to the edge and in the direction in which the mop is rotating, thus lessening any throw-off of composition on to the gun nozzle, due to the air stream caused by the mop.

The gun should also be mounted on an adjustable bracket so that the distance from the nozzle to the mop edge can be adjusted to suit different sized mops. This ensures good adhesion of the composition to the mop and also a constant composition head. The timing device can be either an electrical timer working in conjuction with a solenoid-operated air valve or can be a series of cams so arranged on the automatic polishing machine to actuate the necessary air valves. In either case it is essential that a fairly wide range of adjustment is available so that frequency and amount per application can be varied to suit individual requirements. It has already been found in a number of cases studied that a frequency of applications of from 3 to 15 sec. and a time of spraying from $\frac{1}{4}$ to 2 sec. has been necessary, depending on the composition and the amount of work to be done on the surface, so that it can be seen that this range of adjustments is absolutely essential.

In the case of semi-automatic equipment, a similar gun set-up and timer mechanism is advisable, but the equipment should be so arranged that the timing device is in operation only when the component being polished is in contact with the mop, so that waste of composition is avoided.

With hand-operated spindles, the gun set-up and mounting is exactly the same as for automatic and semi-automatic machines, but here the gun can be operated by means of a foot-controlled air valve, thus eliminating the necessity for the operator to put aside his work-piece when applying composition. This foot operation makes for increased efficiency and more output per manhour. The only disadvantage is that there is no direct control over the application of composition, which becomes entirely dependent on the wishes of the operator.

It has also been found that frequent application of small amounts of composition is far more efficient and more economic than large amounts applied at more infrequent applications, which means that accurate timing mechanism is essential. It also means that consistent quality of the compositions is most important particularly from the point of view of viscosity, as variation in viscosity will result in varying amounts per application from batch to batch. A constant check on viscosity is therefore being made both during manufacture and immediately prior to despatch to ensure that the quality of the compositions is reasonably consistent.

The author's company has, during the past six months, carried out many demonstrations and trial installations at various customers' factories and are constantly learning more about the techniques of liquid polishing compositions. Installations are now in production polishing stainless steel, and mild steel, brass, zinc-base die-castings and electro-deposited copper, and there are also trial installations for aluminium die-castings and aluminium and stainless-steel holloware such as saucepans and pressure cookers.

GOLD-PLATED SATELLITE

In last month's issue of this Journal reference was made to the earth satellite, whose launching early next year is scheduled ny the U.S.A. It was noted that the external bright gold coating on the magnesium shell was deposited from a bright gold solution made by the Sel-Rex Corporation, New Jersey, U.S.A. This gold plating process can be obtained in Great Britain from the Sel-Rex agents in the U.K., M.L. Alkan Ltd., Long Drive, Greenford, Middlesex.

The Decoration of Tinplate

(*Continued from page* 448)

cylinder from picking up the inked image from the blanket and printing it on the lower side of the next tinplate sheet fed through, and is also a safeguard against damage if two or more sheets are accidently fed.

After discharge from the impression cylinder the sheets are conveyed by tapes to the oven for baking.

The register of sheets in the printing machine should be noted. The tinplate sheets are conveyed on to the feed table from the automatic feeder by lug conveyors in much the same way as with the spot coater, but in this case the register edge is the front or leading edge of the sheet and the two reciprocating sheet pushers on the printing machine feed table do exactly what their name implies.

They push the sheet against register blocks on the impression cylinder before the gripper assembly falls onto the leading edge of the sheet and pulls it between the cylinders. The gripper blocks correspond exactly to the spot roller coater sheet pushers, and in this way perfect register is maintained between the two machines.

Today, the industry is employing more and more two colour units, *i.e.*, two single colour machines running in tandem, and very worthwhile results and economies are being achieved. With this equipment, two colours can be printed together and require only one stoving, and if these are the last colours in a job they can be varnished on the tandem coater and thus three operations are achieved with one pass through the oven. Such is the development of technique and increased productivity in this industry today. There is also little doubt that eventually where the demand exists it will lead to the installation of three and four colour metal decorating units.

Conclusion

In presenting this paper, the intention has been to give an overall picture of the principal operations necessary in decorating sheets of tinplate, without being involved with technical language, so that the layman may have a better understanding of the processes involved.

Looking ahead, it is safe to assume that further development will have the object of ensuring greater output and maintenance of still higher quality of print, but this does not necessarily involve any further burden on the people responsible for operating the equipment. Complete automation in the metal decorating industry is still a long way off, but there is little doubt that the field of electronics and scientific process control will have a great influence in future developments.

The Ubryco Process

(*Continued from page* 458)

Generally speaking striations are sharply defined areas of thin deposit, extending across the face of the work. They may take the form of feathered streaks, being most prominent at points of impingement of the air agitation. Occasionally this form of the defect disappears after working the solution for a few hours with dummy cathodes. Another form of the defect may be described as bare patches. These occur at random on odd articles and usually the patches are about $\frac{1}{2}$ to 1 in. diameter. Almost invariably this type is due to insufficient air agitation to the solution.

Striations have been encountered which were caused by organic contamination from nylon anode bags. These took the form of long ridges across the whole medium-current-density surface to the article. They were unchanged in form when the air agitation was turned off. A complete carbon purification was necessary in this case.

Another form of striation occurs in the complete absence of chloride ions. Here the deposit is generally dull and the brightness cannot be improved by adding brighteners. This is the most easily dealt with form of the defect, since a simple addition of sodium chloride immediately restores the solution to a good working condition. The throwing power of the solution is considerably decreased by the presence of oxidizing agents, such as hydrogen peroxide and potassium permanganate. Consequently these materials are not used in purifying the solution. A slight decrease in throwing power may be noticed after a large addition of one the three special brighteners used. However this works out very rapidly and rarely persists after one load of work has been processed.

Adhesion troubles have always been traced to faulty cleaning or to organic contamination of the cyanide copper solution.

Excessive brittleness of the deposit may be caused by adding too much brightener. This has not been encountered in practice when the process is run as a semi-bright bath.

In conclusion, it can be said that although a formidable list of defects has been given, the process is, in fact, reasonably easy to operate. Provided that fairly strict supervision of the bath is maintained, long periods of trouble-free operation can be attained.

The first large installation of the process will be in an automatic plant in Austria. Preliminary trials have proved satisfactory and in this case the process will be replacing a cyanide copper process used for the same purpose. A hand-operated plant has been working for a year in the U.K. where it has operated very satisfactorily.

PLASTIC-COATED SHEET NOW IN PRODUCTION

New Material introduced by John Summers & Sons Ltd

LAST month a brief mention appeared in this Journal about Stelvetite, a new material recently introduced by the Shotton, Chester, steel company of John Summers and Sons Ltd.

Stelvetite is strip-mill cold-reduced steel with a specially formulated Velbex P.V.C. coating developed by the firm in conjunction with B.X. Plastics Ltd. The reverse side of the sheet can have either an electro-zinc or a Bonderized finish. The material can be bent, formed, seamed, deep-drawn, joined and welded without damage to the coating. The surface is warm and pleasant to the touch, and the plastic endows one side of the sheet with excellent electrical insulating properties besides a high resistance to acids and other corrosive elements. The sheet does not support combustion, and is stable at higher temperatures than P.V.C. alone.

The maximum size of sheet available at present is 12 ft. by 4 ft., in thicknesses from 26 to 16 s.w.g. (0.0196 to 0.0625 in.). The P.V.C. coating is 0.014 in. thick, and is supplied in four standard colours—white, and pastel shades of red, yellow and grey. Any other colour can be supplied provided the area ordered at one time is not less than 25,000 sq. ft.

The plastic surface has a standard embossing known as Seal, which resembles a pigskin finish, but other embossings are available, although on a limited scale at present.

The possible commercial applications of the new material can be very wide. Obvious uses for it are for wall panelling, for furniture and for general interior trimming, and for such things as radio, toy, and kitchen equipment.

In cost, the material is cheaper than, for example, stainless steel, and it is claimed that the elimination of normal finishing costs makes Stelvetite an economical proposition. when compared to other unfinished materials. The total cost of applying the coating is said to be about the same as that of applying a high-quality enamel finish.

About the Makers

John Summers and Sons Ltd. are one of the foremost manufacturers of sheet steel in this country, and have taken a leading part in the development of zinc coatings for sheet, both by hot-dip galvanizing and by electrodeposition.

The firm moved to Shotton from Stalybridge towards the end of the last century. Up until 1939, the old hand-mill method of rolling sheets was used, but in that year a new, modern strip mill was installed. Two years earlier, a plant had been installed for the galvanizing of sheets by the continuous process.

NEW HEAT-TREATABLE STAINLESS STEEL

New Firth-Vickers product can be readily welded

A PATENTED type of stainless steel which has now been perfected by Firth-Vickers Stainless Steels Ltd., of Sheffield, type F.V.520, is suitable for both air frames and "skin" purposes, as well as for a variety of industrial applications. It is the only austenitic type of stainless steel hardenable by low-temperature heat treatment. It is available as sheet and strip, bar, castings, and forgings.

Its principal characteristics are : High tensile and fatigue resistance ; stainless properties equivalent to 18/8 steels ; resistance to stress corrosion cracking ; high resistance to notched impact loads at sub-zero temperatures; weldable; thermal expansion equivalent to mild steel ; 500° C. ceiling temperature for service.

F.V.520 provides, for the first time, a stainless steel which combines high strength, low thermal expansion and high corrosion resistance.

Unlike most stainless steels capable of being heat treated to a relatively high tensile strength, F.V.520 is readily welded without preheating. No elaborate precautions are needed to avoid cracks and there is no tendency to peak hardening in the heat affected zones. Maximum hardness adjacent to welds is of the order of 320 Brinell. No heat treatment after welding is needed, although a post weld heat treatment at 550° C. may be considered desirable for purposes of stress relief. Sheet and strip materials exhibit a softer partially austenitic zone immediately adjacent to the weld.

The steel is being produced in coils in thicknesses of 16 to 28 gauge up to 1 metre wide in a condition suitable for many forming operations (0.1 per cent proof stress 25 tons per sq. in.) in which condition it work hardens rapidly. Formed components can be hardened fairly uniformly by low-temperature heat treatments. The steel can also be supplied in a harder condition (30 tons per sq. in.), suitable for mild forming operations, and the post-forming heat treatment specified minimizes the volume change apparent with the strip in the softer condition. A range of sheet sizes, in both conditions, is also available.

Application of Vitreous Enamel by the Electrostatic Process

(*Continued from page* 452)

An electronic spark guard is incorporated in the control system and this is adjusted so that, should any parts to be enamelled approach the high voltage atomizing head or electrodes too closely, the complete installation is shut down and cannot be restarted until the fault has been corrected.

Other equipment previously mentioned can be listed as follows :—reciprocating disc, hydraulic mechanism, mechanically controlled pump together with drive motors and control cabinet housing the various switches, indicators, etc.

The major advantages of the electrostatic process, apart from the reduction in labour, can be summarized as follows :

Savings of up to 50 per cent in enamel consumption can be obtained, dependant upon the vagaries of the collection and re-use of booth scrapings in normal processing.

With high uniformity of coating thinner coats are required to give maximum opacity which, part from saving in material, reduces the tendency to chipping, which is a major problem in the enamelling industry.

By the removal of a major portion of the " human element " and other process variables, consistently good results can be obtained with low reject and rework figures.

DISCUSSION

MR. S. H. RYDER said that the process for paint application described by Mr. Hallsworth would, to the normal layman, seem almost miraculous, and if it could be developed for use with vitreous enamel it might well revolutionize application methods. They had all very much in mind nowadays the question of the direct application of the cover coat to the steel. If a steel or steel preparation was ever available which allowed that to be done they would need better methods of applying enamels to that surface than they had at present, and he believed that electrostatic application would be the answer.

Asked whether it would be possible to do ground-coat application by the electrostatic process, on both sides, since it would be an advantage with the ground coat to get a thin even coat and no drain lines, MR. HALLSWORTH, said that so far he had not been successful in getting an even coating on the back of a steel pressing, which had limited the application of the ground coat from the point of view of applying it on both sides. He was still working on the problem, and felt that there would be an answer either in the way in which the work was jigged or in the use of the backing electrodes. His only suggestion at present would be to spray the ground coat inside by the normal method and then spray the outside and flange electrostatically, and then the cover coat on the outside electrostatically.

Asked whether it would not be possible to use two spinners and pass the work between them, he replied in the negative. The electrical attraction of the work for the enamel meant that any enamel which passed between two sheets was attracted on to the back of the sheet and did not build up uniformly. With a box section it did not matter and the application was quite easy.

Replying to further questions, Mr. Hallsworth said that a flange up to 2 in. could be dealt with and in general all sorts of shapes could be dealt with so long as the depth did not exceed 2in. With an oil medium a satisfactory result could be obtained. When oil was used as a suspending medium the wrap-round became far less intense and it was possible to produce an even coat on the back of the article ; but fine oil was about £8. 8s. per cwt., and to suggest using oil at that price would invite criticism. Experiments were, however, being carried out with it because, it was found that it was possible to coat glass very successfully, but the enamel which had been supplied for the coating of glass used fine oil as its liquid medium. This was a very successful method and atomisation was excellent,

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Continuous Surface Pretreatment

(*Continued from page* 455)

process introduced into the trade in the very near future, he felt that the competition arising from the various improved stoving finishes would become serious, and that a great part of the steel which was at present vitreous enamelled would be coated by these improved stoving finishes. It was not, therefore, a question of whether the trade would prefer to put on one coat or two ; the fact was that economically they had to find a method of putting on one coat. The process described was only one of several which had been put forward over the years towards that end. The type of sheet in question had not yet been produced in any tonnage, but he expected that it would be so in future. If it were possible to offer a one-coat finish which he was sure would be superior to any epoxide finish which was likely to be available in the next ten years, it would give the trade a new lease of life.

With regard to Nitec, the old type of Nitec of two or three years ago had seen the light of day only momentarily and had then ceased to be produced, but they now believed that they had improved it sufficiently for it to emerge again and be used by the trade in the future. They hoped that the trade would express its opinion on the subject in the near future.

FINISHING

NEWS REVIEW

ENAMEL IS NOT PAINT

V.E.D.C. Initiate Campaign to Educate Consumers

"THIS is our first move to make the public and industry conscious of the need to have a good reliable and durable finish to their products. It is our aim constantly to point out to all sections of the community that there is no real substitute for vitreous enamel."

The foregoing statement was made by Mr. N. F. Parker, chairman of the Frit Division of the Vitreous Enamel Development Council in the course of a speech at a recent informal luncheon.

The occasion was one which had been organized by the Frit Division of the V.E.D.C. at which a substantial party of representatives of journals covering the consumer market — with the womens' journals predominating in numbers, spent a morning visiting the works of two well-known manufacturers of vitreous enamelled products.

The Vitreous Enamel Development Council has been aware that over the past decade there has been much ill informed criticism of enamel, the main reason for which, in the Council's view, has been the almost complete ignorance shown by the majority of the general public — the housewife in particular, and some manufacturers, as to the meaning of the words "Enamel finish" and the exact nature and properties of a vitreous enamel coating.

In recent years the term enamel has come to be applied not only to vitreous (or porcelain) enamel, but also to paints capable of producing a high-gloss and moderately scratch resistant surface. The object of the visit organised by the V.E.D.C. was to stress to the general public and the consuming industries the difference between paint and enamel.

The first of the works visited by the press party was that of Belling and Co. Ltd., manufacturers of electric cookers and electric fires. Here the full enamelling process was followed from the milling of the enamel frit and the surface preparation of the steel sheets right through to the application of the enamel slip by dipping or spraying and its final fusion at bright red heat in a continuous conveyorized furnace.

There is no doubt that the sight of a large number of cooker components emerging from the furnace with the enamel coating fused to the metal surface, effectively brought home to the party the fact that enamel differs considerably from paint. This fact was emphasized still further in the course of the visit to the next works, the factory of R. and A. Main Ltd. Here, while able to study the application of enamels to gas cookers, water heaters and refrigerators, the party was also shown the actual manufacture of enamel frit. The dramatic shattering of the molten glass as it was poured from the smelting tank into water made abundantly evident the entirely inorganic nature of vitreous enamel.

Following the visit the party was entertained to luncheon by members of the Frit Division of the Council and were afterwards briefly addressed by Mr. Parker, chairman of the Division. In the course of his remarks, Mr. Parker referred to the opening of a new Enamel Advisory Service for the general public and for industry. The service had been set up to deal with the many problems encountered with protective coatings and finishes on domestic and industrial products. The Service would be available to the general public, who had problems from the consumers' point of view, and also to manufacturers who were in need of further information regarding the possibility of finishing any of their products with vitreous enamel. The address of the Enamel Advisory Service is 11, Ironmonger Lane, London, E.C.2. Telephone : Monarch 8888.

In concluding his remarks Mr. Parker said that while it was the obvious aim of the Council to promote the use of enamel, it also wished to go much further than that. They sought to increase the quality consciousness of the public and to stimulate a proper appreciation of colour and design.

VOLUNTEER FILM UNIT

Employee Project at Baker Platinum

A PROJECT has been launched by a volunteer group of employees who aim to prove to the Baker Platinum Division of Engelhard Industries Ltd. that films are indispensible to training, sales promotion and general publicity. In their own time and with their own money they are making a film of a complicated industrial process.

Baker Platinum are refiners and workers of precious metals, from which are made alloys to serve almost every branch of industry. The first film now being made, covers many of the company's manufacturing processes.

The idea of forming a Baker Platinum Film Unit originated at the time employees were shown a number of industrial films produced by other companies. These films generated a spontaneous demand for a similar organization capable of filming precious metal processes, and offering a fertile source of recreation.

Few of the members possessed much experience at the commencement of operations. The Group represents a typical cross-section of personnel from the work's director downwards. It was found that experience in other directions did not necessarily indicate an ability for film production, and considerable amusement has been experienced during the first attempts at film making. These incidents, however, form part of the recreational value of the project.

The unit meets weekly and after an initial orientation, proceeds to view the shots taken the previous week and analyse the qualities of the work. The members then proceed to film the particular operation in the works which has been assigned by the script writers for that week. A small contribution is made by each member to ensure that the Unit is self supporting, and everyone endeavours to provide some personal piece of equipment — if only a lamp plug — to help towards the necessary apparatus. Ingenious improvisations are made as and where necessary to keep the work moving.

Societies Link-up

THE Institution of Chemical Engineers, 16 Belgrave Square, London, S.W.1., has joined the European Federation of Chemical Engineering, which aims to promote the furthering of European co-operation in the field of chemical engineering. Apart from its new London secretariat, the Federation is represented by DECHEMA, Deutsche Gesellschaft für Chemisches Appatewesen, in Frankfurt-on-Main, and by the Société de Chimie Industrielle in Paris.

OBITUARY

Dr. Paul D. Merica of The International Nickel Co. of Canada Ltd., died in New York recently at the age of 68. Joining International Nickel in 1919 as head of research, he retired in 1954 after a two-year term of office as president of the company.

American born, he gained his Ph.D. at the University of Berlin in 1914, after graduation from the University of Wisconsin, U.S.A. A member of many learned societies including the British Institute of Metals and the Iron and Steel Institute, he evolved numerous alloys of nickel, and his work in the metallurgical field had earned him many prizes.

NICKEL EXHIBITION IN NEWCASTLE

An exhibition to bring industry the latest information about the uses and developments of nickel, nickel alloys and related materials, was held by The Mond Nickel Co. Ltd. at the Royal Station Hotel, Newcastle upon Tyne, from November 5-8.

Numerous displays and working demonstrations were on view, to show corrosion resistance, surface protection, high magnetic permeability, weldability, controlled expansion, and mechanical properties at temperatures between 900°C and sub-zero. Part of the exhibition was devoted to spheroidal graphite cast iron, and featured specimens and mechanical strength tests.

Illustrated above is an automatic materials selector having four dials, each one representing a main design factor, which could be set to a selected position. By pushing a button, a lamp illuminated the most suitable of 60 alloys to meet the selected specification. The selector proved to be a great attraction.

Jubilee Show

THE 1958 Daily Mail Ideal Home Exhibition will be held at Olympia from March 4 - 29. Founded in 1908, this will be its Golden Jubilee show.

Officers Elected

THE Pennsylvania (U.S.A.) Ceramics Association has elected Mr. Ernest M. Hommel of the O. Hommel Co. president for a term of two years. Others elected were Mr. John Clark of the Foote Mineral Co., and Mr. George Reuning of the Big Savage Refractories Corpn., first and second vice presidents, and Mr. James K. Martin of Posey Iron Works, managing director. Member companies of the Association sponsor scholarships in ceramics engineering at the State University.

DEPOT OPENED

ON the left is the new depot opened by the Electro-Chemical Engineering Co., Sheerwater, Woking, Surrey, at Chaddock Lane, Astley, near Manchester (telephone Atherton 1364). Its initial use will be as a store for Efco-Udylite products and chemicals, but later it is hoped to install laboratory facilities. The manager is Mr. H. Maxwell.

TECHNICAL *and* INDUSTRIAL APPOINTMENTS

Mr. J. R. Stanfield has been appointed works director of **Fisher and Ludlow Ltd.,** Birmingham, with a seat on the main board, relinquishing his position as chief designer (cars) of the Austin Motor Co. Ltd.

After serving an apprenticeship in body building, Mr. Stanfield joined the body design staff of Morris Motors Ltd., Cowley, transferring to Wolseley Motors Ltd. as assistant manager of the body department. In 1937 Mr. Stanfield joined Austin's to supervise air-frame manufacture in the shadow factory, subsequently taking charge of all the wartime air-frame production at Longbridge.

He returned to vehicle body design at Longbridge in 1945, and was chief designer (bodies) until taking control of car design there earlier this year.

* * *

Metropolitan-Vickers Electrical Co. Ltd., Trafford Park, Manchester, 17, has appointed Mr. W. C. Clegg, previously assistant purchasing agent, to be purchasing agent, replacing Mr. G. T. King who has retired from executive duties. Mr. Clegg joined Metropolitan-Vickers in January, 1956, as assistant purchasing agent.

* * *

Mr. E. D. Robinson, formerly assistant manager of London area sales office of the **Northern Aluminium Co. Ltd.,** Bush House, Aldwych, London, W.C.2, has taken up the appointment of area sales manager in charge of the Manchester office in succession to Mr. D. A. Corbett-Thompson who has been appointed sales manager in charge of export sales.

Mr. M. Bridgewater, who has just completed a year's study at the Centre d'Etudes Industrielles, Geneva, becomes manager of the sales development division, Banbury. He succeeds Mr. E. D. Iliff who has been appointed sales manager in charge of sales development, advertising and publicity.

* * *

Wolf Electric Tools Ltd., Pioneer Works, Hanger Lane, London, W.5, have appointed Mr. H. A. Herzogenrath as sales representative to handle their industrial and domestic range of portable power tools in the Dutch market. He was for five years sales export manager of a department of the Dutch firm of Edelstaal, and before that sales promotions manager for K.L.M.'s Latin American division. He will be working closely with Wolf's already well-established agents in Holland, Joh. Westhof Im-En Export Mij., N.V., Dr. Kuyperstratt 23, The Hague.

* * *

Mr. G. M. Keightley has been appointed manager and Mr. R. E. Bayliss has been appointed assistant manager of the British sales division of **The Consolidated Pneumatic Tool Co. Ltd.,** Fulham, London.

Mr. Keightley was formerly manager of the company's branch in Manchester. He joined the firm in 1936 and specialised in mining business for ten years. He spent about eighteen months during this period on the Ministry of Fuel and Power's programme of American mechanization methods in mines.

Mr. Bayliss joined the company in 1924 and until his new appointment was manager of the Leeds office. The previous manager of the sales division, Mr. C. L. Fisher who is a director of the company, is to take over duties on a broader basis.

* * *

Mr. D. L. Jones has been appointed road transport engineer of the **Aluminium Development Association,** 33 Grosvenor Street, London, W.1. He was at one time a senior designer with the Regent Oil Co. Ltd., and joins the Association from the Ford Motor Co. of Dagenham, where he was responsible for design, development and construction of all road tank vehicles, pumping gear, ancillary equipment and special purpose bodies.

* * *

The British Aluminium Co. Ltd., Norfolk House, St. James's Square, London, S.W.1, announce that Mr. P. S. W. Swabey has been appointed assistant general sales manager. He was at one time an assistant development manager, and has had a considerable period of service with the company.

* * *

The marketing of the chemical products of the Wakefield Group of Companies is to be carried out through a member company, **Edwin Cooper and Co. Ltd.,** whose board of directors have been reconstituted. Mr. L. M. Broadway and Mr. W. Helmore have been appointed chairman and deputy chairman respectively. The managing director is Mr. G. H. Thornley, and directors appointed are Mr. W. F. List, Mr. G. E. T. Eyston, Mr. J. A. V. Watson, Mr. L. G. Packham, Mr. J. C. Cragg, Mr. C. R. Woodfield and Mr. L. Colkett, who has also been appointed secretary.

MEETINGS OF THE MONTH

November 18

Institute of Vitreous Enamellers Ltd. "The Application of Electrostatic Spraying to the Vitreous Enamelling Industry," by S. Hallsworth at the Exchange and Engineering Centre, Stephenson Place, Birmingham, at 7.30 p.m.

November 20

Institute of Metal Finishing. "The Paint Maintenance of Public Service Vehicles," by A. Gellman, at the Exchange and Engineering Centre, Stephenson Place, Birmingham 2, at 6.30 p.m.

December 13

Institute of Metal Finishing. "Choice of Phosphate Pre-treatments," by R. F. Drysdale, at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1, at 6.30 p.m.

December 17

Metal Finishing Association. Open Discussion Meeting. Luncheon meeting at the Farcroft Hotel, Rookery Road, Handsworth, Birmingham 21.

December 18

Society of Chemical Industry. "Teaching Corrosion Science"; "Existing Facilities," by L. W. Stubbs. "Future Requirements," by T. P. Hoar, at 14 Belgrave Square, London, S.W.1, at 2.30 p.m.

December 18

Institute of Metal Finishing. "The Large-Scale Finishing of Furniture," by V. P. Gellay, at the Exchange and Engineering Centre, Stephenson Place, Birmingham 2, at 6.30 p.m.

COPPER SULPHATE FOR ELECTROPLATING

THE art of electroplating is as dependent on good materials as on the skill of the operator. Hence the importance of a new specification for copper sulphate, B.S.2867:1957, recently issued by the British Standards Institution, 2 Park Street, London, S.W.1. The new standard is the tenth in a series devoted to chemicals used in electroplating.

Requirements are specified for chemical composition of the crystals ; and the extent of the permissible impurities is laid down. The standard contains a recommendation that, wherever possible, British Standard laboratory glassware be used when carrying out the tests specified in the appendices. The tests (for which procedures are described in detail are for the determination of : copper, nickel, iron, arsenic, insoluble matter and chlorides. Copies of the standard are obtainable from the British Standards Institution sales branch, price 3s.

Company Forms a New Division

Mr R. B. Olliver

THE Hemel Hempstead firm of Roto-Finish Ltd. are forming a new division to develop and market new processes and products.

The new subsidiary will be called the Roto-Finish European Metal Finishing Division and will operate from the parent factory.

A team of specialists in various fields will be led by Mr. R. B. Olliver, director of Roto-Finish Ltd., who has been responsible for organizing the division. Also in the team will be Mr. H. Evans, the parent company's chief metallurgist, Mr. N. H. Mack, a newcomer to Roto-Finish with fourteen years experience in the metal pre-treatment and finishing industry, mainly on protective processes, and Mr. E. W. Fondyga, a plating specialist with eighteen years' experience.

Most of the processes and products which will form the nucleus of the range to be handled by the new division have been developed on the Continent, but have not been introduced previously to this country.

The Company plans to add new or improved metal finishing processes to its present range as and when they are discovered if they show a distinct advance over existing methods in use. Many of the company's present range of processes and products have a German origin.

Chemical Products

A FURTHER expansion of the trading interests of the Wakefield Group of Companies, headed by C. C. Wakefield and Co. Ltd. of Castrol fame, was announced recently.

Some of the additives which the group produces for its own lubricating oils and other chemical products, not necessarily connected with lubricants, are to be made available to the outside market through a member company, Edwin Cooper and Co. Ltd.

Some German Methods for the Testing of Surface Finishes

ONE name that is commonly linked with a method of testing the deep drawing quality of sheet and strip metal and the technological properties of coating materials is that of Erichsen.

The Erichsen cupping test has established itself throughout the world since its introduction in 1912, and has now been standardised under DIN 50-101, the Euronorm 14-55, the new DIN 53-156 for coating materials, and many other standards.

As an engineering firm, A. M. Erichsen was founded in Berlin in 1910, and was later reconstructed at Hemer-Sundwig, Westphalia, under the leadership of Dr.-Ing. Per F. Erichsen and the general manager Ing. Hans Weber. A development department and laboratory for coating materials headed by paint-chemist Gerhard Eberle aims to provide the lacquer and paint industries with up-to-date test methods and testing instruments, and many well-known German scientists take an active part in this work.

The Erichsen lacquer and paint testing method consists of applying a coating, by a standardised method, to deep-drawing mild steel sheet. After a specified drying period, the specimen is deformed by a standard ball punch.

The sheet is then bent and stretched simultaneously until the first cracks appear in the coating. The working movement of the punch up to this point is described as the "Erichsen depth," and is a measure of elongation and adhesion. The formation of the crack can be observed by using an Erichsen electro-test which has the advantage of eliminating operator error, possible when using a microscope or the naked eye. The electro-test has the added advantage of showing up porosity in the coating material.

Another test can be made to test the properties of lacquer applied to metal sheet that is subjected to certain types of deep drawing processes, for example, in the can making industry. This test is designed to reproduce the conditions of deformation experienced in practice. Blanks of 64 mm. diameter are cut and a standard cup is then drawn, using a cylindrical drawing punch 33 mm. diameter and a sheet holder as in normal deep drawing operations. The quality of the stamping lacquer is examined visually or measured quantitatively using the Bead test.

These are only two of a series of interesting tests that can be applied to surface finishes contained in a catalogue recently issued by the firm through their agents in Britain, Messrs. Pearson Panke Ltd., 1-3 Hale Grove Gardens, London, N.W.7. Although the catalogue describes and illustrates the testing machines made by the firm in the briefest way, it will nevertheless be of immense interest to those in the industry, and further detailed descriptions of equipment can be obtained upon request.

TRADE and TECHNICAL PUBLICATIONS

"Epinamel — A.C. Protective Coatings": Issued by Arthur Holden and Sons Ltd., Bordesley Green Road, Birmingham 9, this is a booklet describing the use of Epinamel as a protection against corrosion. The material is based on epoxy resins modified with suitable amines.

As a coating it has a high resistance to an extensive range of chemicals in liquid or solid form at high or low temperatures, and has a drying process resulting from the interaction of various components in the coating which provides uniform drying and hardening throughout the film, even in very thick coats. It can be applied by brush or spray gun.

The booklet gives directions for the preparation and use of the material and a table of tests that have been carried out when used with various chemical compositions.

"Pretreatment and Finishing Plant": For many years, the Stordy Engineering Organization, Cumbria House, Goldthorn Hill, Wolverhampton, has specialised in all branches of thermal engineering applied to industry and this catalogue describes and illustrates some of the plant available, including the ancillary equipment of control gear and mechanical handling apparatus. The catalogue is divided into sections covering pretreatment, spray phosphating and drying plant, and finishing.

The standard now being called for in modern finishes demands not only close control of finishing materials, but also pretreatment of the base metal which has to receive the paint finish.

The pretreatment process will vary depending on the type of work and the degree of final finish required, and also on the quantity and size of workpiece.

Essentially, the pretreatment process will cover degreasing, cleaning and the preparation of a key surface best suited to give maximum adhesion of the paint or coating to be applied.

The section on finishing contains illustrated descriptions of a variety of plant for dipping, both hand and automatic, hand spraying, electrostatic spraying by the fixed gun and spinning cup processes, and also flow painting.

"Foscote": Issued by the Walterisation Co. Ltd., Purley Way, Croydon, Surrey, this is an introductory leaflet to the series of treatments which has been designed for cold brush-on application to rusty iron and steel, aluminium or galvanized surface. The coating is designed to give improved adhesion of subsequently applied paint films and increased corrosion resistance of the complete finishing sequence.

Foscote is supplied in three separate packs for various applications, and the leaflet describes where each of these should be used. For example, galvanized steel surfaces have a natural "greasy" nature which makes the effective adhesion of paint films difficult. The form of Foscote adapted for use with this material precludes the common practice of leaving the galvanized surface to weather by outdoor exposure before applying the paint, and the already high protective value of the galvanizing is enhanced by the additional coating. The treatment can be used with most zinc materials.

"Lead": The importance of lead used as a safety shield in nuclear laboratories is described in the recent issue of this quarterly publication of the Lead Industries Association, 60, East 42nd Street, New York 17, N.Y., U.S.A. A variety of such applications at Manhattan College in New York City, U.S.A., are described, where the utmost precautions are taken to protect students and instructors from exposure to harmful radiation.

In contrast, the issue also describes the use of lead in the Ethyl Corp. research laboratories, where it is employed to protect highly sensitive instruments from inaccuracy caused by the proximity of radioactive materials.

Also featured is the new Mackinac Bridge connecting the northern and southern peninsulas of Michigan. The structural steel of this suspension bridge, believed to be the longest in the world between anchorages, is painted with a priming coat of red lead base paint. In the same issue are articles describing the uses of lead in building construction. Copies may be obtained free from the Association.

"Spelter Pump": This is a leaflet issued by John Thompson (Dudley) Ltd., Windmill Works, Dudley, Worcs., to describe and illustrate the JCJ spelter pump which they make. It is an electrically driven centrifugal pump especially constructed for quick and effective handling of molten zinc, tin and lead in the daily work of a galvanizing plant.

NEW COMPANIES

"Ltd" is understood, also "Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Westwood Paint and Varnish Co., September 11. £1,000. F. H. Leech, P. K. Leech.

Shot Blasting and Metal Spraying Co., Liverpool House, 15/17 Eldon Street, E.C.2. September 23. £5,000.

Lanuit, 36, Broadwater Road, Worthing. September 24. £100. To carry on bus. of manufacturers of and dealers in paints, varnishes, enamels, etc. H. K. Tutton and Mrs. V. M. Tutton.

Watsons' Anodising, Clough Lane, Hightown, Liversedge, Yorks. September 27. £100. To carry on bus. of screen printers, anodisers, etc. H. G. M. Watson, G. L. Murphy.

F. L. Penfold, Mull Works, Albert Road, North, Reigate, Surrey. October 3. £1,000. To carry on bus. of welders, shotblasters, metal finishers, etc. F. L. Penfold and Mrs. E. E. Penfold.

Myco Metal Processers, 22, Florence Road, Sutton Coldfield, Warwicks. October 4. £5,000. To take over bus. of chemical processes and colouring of metals and working and exploiting of processes in connexion therewith, being part of the bus. carried on by Metal Processes Ltd., at Kingsbury Road, Erdington, Birmingham. M. Cooper, L. Deathridge.

Corrosion Prevention, 8, Victoria Avenue, Harrogate. October 4. £1,000. To take over bus. of dealers in materials and equipment for the prevention of corrosion in metals carried on at 106 Kings Road, Harrogate, as "Anogal Corrosion Prevention Co." etc. R. B. T. Yuen and Mrs. A. Yuen.

Rees and Edwards (Electroplaters), New Road, Neath Abbey, Skewen, Glam. October 7. £1,000. D. N. Rees, A. J. Edwards, Mrs. S. E. Rees and Mrs. R. Dawkins.

Electrochemical Developments, 82, Portland Place, W.1. October 9. £100. Ann Chatterley, E. C. Batstone.

From the Register compiled by Jordan & Sons Ltd., 16, Chancery Lane, London, W.C.2.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Shot Blasting Machine

THE Major shot-blasting machine is a modified and improved version of the superseded Standard machine made by Vacu-Blast Ltd., 291, Aberdeen Avenue, Slough, Bucks. It employs assembly parts which are largely inter-changeable with the standard model, and all the attachments for use with the Standard can be used with the Major.

The machine comprises a generator-reclaimer and a dust collector. These two units may be sited individually at some distance apart or they may be integrated to form a single un it. Lifting hooks are provided to enable the respective units or the integrated machine to be slung according to the needs of the work in hand. In the composite form the floor space occupied is only 7′ 7″ x 3′ 6″ the over-all height being 8′ 2″ and the weight of 3,000 lb.

A plug outlet is provided in the reclaimer section to enable quick removal of debris withdrawn from the work surface. The dust collector's cylindrical air-filtars unit comprises sock-type filters, giving an increased cloth-to-air ratio, thereby improving the efficiency of the final air filtration.

The Major can be supplied as a continuous cycling (C.C.) or a non-continuous (N.C.) unit. The C.C. version ensures a continuous supply of abrasive and is required for mechanised operations where grit blasting must continue for several hours without interruption. The N.C. version requires a brief interruption in blasting for approximately thirty seconds every five or six minutes, and this model is more generally preferred for all dis-continuous grit blast applications.

A smaller version of the high production gun illustrated in Fig. 1., has been introduced for use with this machine. The Senior high production gun was designed for millscale removal from large areas of flat plate, and this smaller counterpart will suffice for many whose output of steel plate may not warrant the large Senior installation.

In addition to the high production gun for plate descaling, there is the standard gun, long gun and small gun for vertical and overhead grit blasting; the dual gun for plate-edge preparation and a selection of attachments for cleaning tubes from one-eighth inch bore upwards. Blast cabinets for cleaning intricate castings, or the pass-through cabinet for cleaning structural sections, can also be supplied both of which are operated with the Major machine. The machine has been successfully applied to many industries since its recent introduction.

Fig. 1. The high production gun for use with the shot-blasting equipment.

Controlled Electrode Instrument

WHAT is claimed to be the first commercial instrument of its kind was recently announced by the Shandon Scientific Co. Ltd., 6 Cromwell Place, London, S.W.7.

The instrument called a "potentiostat" has been designed to maintain an electrode potential at any desired value. Since the electrode potential is controllable, one constituent alone, among a number in a solution, may be made to react without interference from other constituents.

The potentiostat makes use of a third electrode placed in the electrolyte and connected to a circuit drawing negligible current. This electrode monitors the potential between the electrolyte test electrode; the monitored value is used to control the supply so as to maintain the required constant potential.

Possible applications are innumerable. It can be used for controlled etching or as a polarograph, to mention two examples.

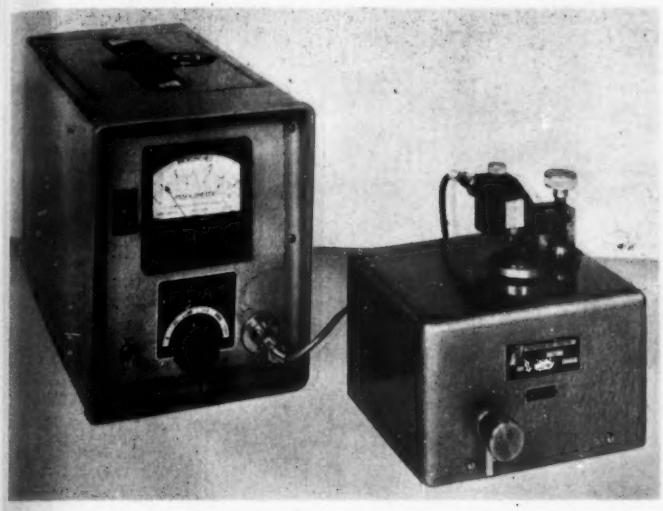

Fig. 2 (left) Concentricity instrument

Fig. 3 (above) Ceramic element filter

Concentricity Instrument

THE Profilometer type PE rotary table "pilotor," illustrated in Fig. 2, marketed by the Micrometrical Manufacturing Co., 345 South Main Street, Ann Arbor, Michigan, U.S.A., can be loaded easily, and provides a circular tracing motion for measuring the roughness of concentric diameters on flat surfaces.

The rotary table has concentric circles cut in its face to facilitate the location of workpieces. In use, the piece to be measured is placed on the table (shown on the upper surface of the instrument on the right of the illustration) in the centre of one of the inscribed circles. The tracer then remains stationary while the table and workpiece piece rotate. The height of the tracer can be adjusted by a finger control to accommodate a wide range of parts. Some typical applications to which the rotary tracer has been put include the measurement of refrigerator seals and valve seats.

The MA tracer is used with a standard Profilometer "amplimeter", the instrument shown on the left of the illustration. U.K. agents for this equipment are Gaston E. Marbaix Ltd., Devonshire House, Vicarage Crescent, London, S.W.11.

Filter Units

FILTER units, now available in a wide range of sizes and materials for virtually all industrial applications have, been developed from over 25 years research on porous industrial ceramic media by Aerox Ltd., Lister Place, Glasgow, S.W.2. One of the latest forms is an excellent water-repellent media, "Persilex SP35," of especial interest in the pressure range of 150—200 lb. per sq. in. For most filtration applications up to pressures of 7,000 lb. per sq. in. the porous ceramic element has been found to be efficient and economical.

The illustration (Fig. 3.), shows a new type of Aerox filter unit employing Persilex, which can free an air or gas stream of moisture and solid particles down to one micron in size. The unit shown has an automatic drain trap than can now be fitted to standard filters of this type. For the higher rates of flow, e.g. 100 cu. ft. per min. of free air, a different type of element can be fitted which will provide filtration down to ten microns.

Pretreatment Primer

SUPPLIED as a two-part system, "Supra" etch primer and metal conditioner is a product of Supra Chemicals and Paints Ltd., Hainge Road, Tividale, Tipton, Staffs. It comprises a pigmented base paint and an accelerator thinner, which when mixed, can be applied either by brush or spray. It can be stove dried if required.

The makers claim that the coating is at least equivalent to shop-applied pre-treatments on metal. The treatment results in a complex resin chromate phosphate formed on the surface of the metal which meets the objection to an aqueous-acid treatment. It has excellent adhesion to clean metal surfaces, is easily applied under a wide range of temperature and humidity conditions, and forms a uniform film to provide a temporary protection against corrosion or an excellent base for finishing treatments.

Precision Surface Grinders

THE Abrasive Machine Tool Co., East Providence, Rhode Island, U.S.A., has recently announced a new line of hydraulic precision surface grinders. The company says that the new line has many innovations, chief among which are big capacity, a new spindle design, a new design

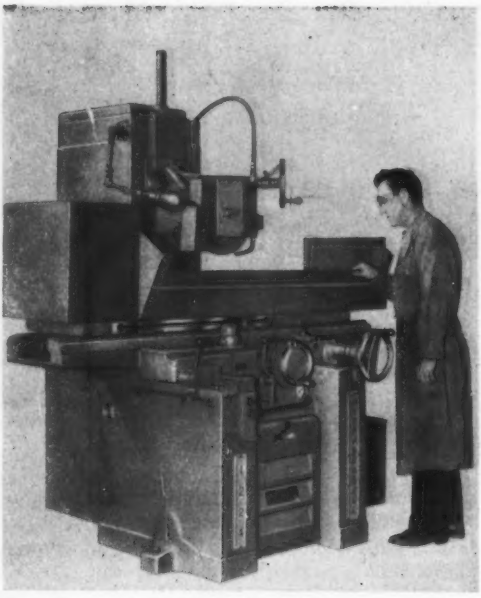

Fig. 4. Surface Grinder

eliminating heat generally encountered with hydraulic powered machine tools, and a unique cross-feed saddle adjustment (Fig. 4).

To provide flexible capacity, all the standard models have 12 in. of grinding clearance to the table under a 12-in. wheel. Optionally, they can be built with 18 in. under a 12-in. wheel. Also, 24-in. models can be safely extended to 30 in. in length without sacrificing strength or accuracy.

For trouble-free operation, the spindles are cool running, with sealed-in lubrication and anti-friction pre-loaded bearings. They are precision ground from special spindle steel and are powered by "soft" running motors. All components are dynetrically balanced after assembly. To eliminate any possibility of binding on the column ways, the head and spindle assembly is balanced on the elevating screw.

What is claimed to be a unique abrasive design minimizes heat usually associated with hydraulically-powered machine tools. The Hydrabrasives have two hydraulic cylinder rams to actuate the table, each of which is under pressure for only half the operating time, and oil cushions absorb all shock at the end of each stroke. The hydraulic system is of comparatively low operating pressure, 200 lbs., and is compact and simple, being easily removed for inspection or maintenance. The normal temperature rise in the system is 20°F and the entire power unit is cooled by a large volume air flow over the system and up the column.

For accurate transverse saddle adjustment, Hydrabrasives have a precision ground cross-feed screw with a backlash eliminator and ball bearing saddle ways. The saddle moves on ¾ in. steel preloaded ball bearings on hardened steel square ways, and the hydraulic motor turns the screw for rapid saddle traverse when dressing the wheel.

The controls are conveniently grouped for easy operation, being mechanically interlocked for positive safety. The elevating hand wheel is located on the head, and all other controls are engineered to allow the operator to work in a natural, comfortable position during each operation.

Classified Advertisements

Prepaid rates: FIFTEEN WORDS for 7s. 6d. (minimum charge) and 4d. per word thereafter, or 24s. per inch. Box number 2s. 6d., including postage of replies.

MACHINERY FOR SALE

NEW JOHANNSEN SHEET METAL GRINDING & POLISHING MACHINES for sale. Motor driven 400/440/3/50. Single and double belt models in four sizes to take all kinds of sheet metal up to 9′ 11″ x 4′ 11″. Full details and illustration from F. J. Edwards Limited, 359, Euston Road, London, N.W.1. Euston 4681, or 41, Water Street, Birmingham 3, Central 7606.

ROTOFINISH Rumbler Machine for sale (Model DW60.36.2), double compartment, work load 400lb. parts comp. with Screen.—Burleigh, Alpine Works, Empire-way, Wembley 1900.

BUSINESS FOR SALE

EXCEPTIONAL BUSINESS OPPORTUNITY

Well known Manufacturing Group wish to dispose of their Plating Factory as a going concern. Situated 30 miles from London in a good labour area, freehold premises consisting of main Factory 5,200 ft.; subsidiary buildings, office, canteen etc., 3,400 ft.; in all 8,600 ft., with additional 12,000 feet hard standing, fully equipped with modern plating and anodising plant. Fully trained staff available if required. Vendors would be willing to give their work to Purchaser. Price to include Factory, Plant and Stock £28,000. Box No. 530, METAL FINISHING JOURNAL.

PATENT

As Chemical Manufacturers, we are interested in examining un-developed Patents or processes suitable for sale to Engineering and Allied Trades, with a view to development. Give brief outline in initial stage to Box No. 529, METAL FINISHING JOURNAL.

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